

JPRS-CST-86-032

15 AUGUST 1986

# China Report

SCIENCE AND TECHNOLOGY



FOREIGN BROADCAST INFORMATION SERVICE

#### NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

#### PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

15 AUGUST 1986

# CHINA REPORT SCIENCE AND TECHNOLOGY

## CONTENTS

### PEOPLE'S REPUBLIC OF CHINA

#### NATIONAL DEVELOPMENTS

- History, Future of Computer Applications Reviewed  
(Li Xianglin; JINGJI RIBAO, 5 Jun 86) ..... 1

#### APPLIED SCIENCES

- Performance of V-Type Flameholder in Afterburner Improved  
(Tan Haoyuan, Wang Jiahua; GONGCHENG REWULI XUEBAO, No 2,  
May 86) ..... 6
- Pressurized Combustion Test of Coal-Water Mixture as Gas Turbine Fuel  
(Gao Lijun; GONGCHENG REWULI XUEBAO, No 2, May 86) ..... 10

#### SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

- LIAOWANG Hails Atomic Bomb Specialist Deng Jiaxian  
(Gu Mainan; LIAOWANG, No 25, 23 Jun 86) ..... 16

#### ABSTRACTS

#### APPLIED MATHEMATICS

- YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA], No 4,  
Oct 85 ..... 25

TIANJIN DAXUE XUEBAO [JOURNAL OF TIANJIN UNIVERSITY], No 1, Jan 86	29
YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA], No 2, Apr 86 .....	30
CHEMISTRY	
HUAXUE XUEBAO [ACTA CHIMICA SINICA], No 4, Apr 86 .....	37
HUAXUE SHIJI [CHEMICAL REAGENTS], No 2, 28 Apr 86 .....	45
ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI], No 2, May 85 .....	47
DYNAMICS	
ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI], No 2, May 85 .....	49
ELECTRONICS	
DIANZI XUEBAO [ACTA ELECTRONICA SINICA], No 3, May 86 .....	50
IMMUNOCHEMISTRY	
BEIJING YIKE DAXUE XUEBAO [JOURNAL OF BEIJING MEDICAL UNIVERSITY], No 2, 18 May 86 .....	62
LASERS	
ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS], No 2, 20 Feb 86 ....	63
ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS], No 6, 20 Jun 86 ....	68
MATHEMATICS	
SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)], No 2, 1986 .....	76
ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI], No 2, May 85 .....	78
MECHANICS	
TIANJIN DAXUE XUEBAO [JOURNAL OF TIANJIN UNIVERSITY], No 1, Jan 86	80
OCEANOLOGY	
HIAYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA], No 1, Jan 86	81

ORGANIC CHEMISTRY

- SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)], No 2, 1986 ..... 83

ORTHOPEDICS

- BEIJING YIKE DAIXUE XUEBAO [JOURNAL OF BEIJING MEDICAL UNIVERSITY], No 2, 18 May 86 ..... 84

PHYSICAL CHEMISTRY

- SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)], No 2, 1986 ..... 85

- TIANJIN DAXUE XUEBAO [JOURNAL OF TIANJIN UNIVERSITY], No 1, Jan 86 87

PHYSIOLOGY

- SHENGLI XUEBAO [ACTA PHYSIOLOGICA SINICA], No 2, Apr 86) ..... 88

SPACE SCIENCE

- KONGJIAN KEXUE XUEBAO [CHINESE JOURNAL OF SPACE SCIENCE], No 1, Jan 86 ..... 90

/9986

## NATIONAL DEVELOPMENTS

### HISTORY, FUTURE OF COMPUTER APPLICATIONS REVIEWED

Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 5 Jun 86 p 2

[Article by Li Xianglin [2621 4382 2651]: "China's Computer Applications Begin To Open Up"]

[Text] During the period of the "Sixth 5-Year Plan," computer applications in this country developed more rapidly, and to varying degrees they have penetrated into some important fields within construction of the national economy and life in society. They have made outstanding gains, and have come across some experience that has done more for laying the foundation for the "Seventh 5-Year Plan."

#### Computer Applications Have Developed Quickly

While focusing on the persistent self-reliance of the party, supplemented by help from outside, and under the guidance of the policy to import advanced foreign technology to develop socialist economic construction in this country, it has now been 30 years since the initiation of the development of China's computer enterprise. Since the 3d Plenary Session of the 11th CPC Central Committee, the party and the state have made the use of computers to transform traditional industries highly strategic, and have formulated a developmental strategy for our electronics and information industries. Through the arduous efforts of the vast numbers of scientists and technicians and workers in computer applications departments throughout the country, computer applications in China have begun to open up.

Research and development projects in computer applications have developed from a few hundred achievements to more than 20,000, and applications fields have expanded quickly. From fields primarily centered in science research and national defense and in key national projects, they have made their way to varying degrees into the areas of energy, transportation, communications, metallurgy, chemical engineering, mechanics, electronics, finance, commerce, agriculture, national defense, public safety, science and technology, culture and education, physical education, and hygiene. Large scale data and service systems in areas of the national economy like information, banking, electricity networks, weather, and public safety have begun building up and have had a good start.

In 1980 there were some 2,900 computers that were not microcomputers installed throughout the country, with only some 600 microcomputers. This has developed until now there are more than 7,000 non-microcomputers and more than 130,000 microcomputers. Among these, some computers of all types can handle both English and Chinese processing.

In 1980 there were only 20,000 scientists and technicians in this country involved in computers. Now, they have begun to make up a scientific and technical contingent of about 100,000 that is hierarchical and that engages in computer research, technology development, industrial production, teaching, and technical services. In addition, there are more than 5,000 teachers involved in elementary and middle school teaching and in extra-curricular activities.

In 1980 the technical base for computer applications was still quite weak, and it lacked general use supporting software and basic technical methods. Changes have been made after years of hard work, and there have been outstanding advances in the extent of applications: a quantity of supporting software has been successfully used in various systems, as well as has a number of software packages for different applications fields; work has begun on the building of multi-type databases of different scales and of economic and mathematic models; applications and theoretical methods have been researched and developed for manual seismic prospecting numerical methods; throughout the country, work has begun on basic research in researching basic information standardization and safety and security; there have been great advances in Chinese language information processing technologies, and the writing symbols for 11 nationalities, including Chinese, Mongolian, and Tibetan, are being handled by computer to varying degrees.

#### Computer Applications Have Played an Important Role

As the electronics and information industries in this country have shifted toward serving development of the national economy, the four modernizations, and activities throughout society, computer applications during the period of the "Sixth 5-Year Plan" have had quite marked results.

First, they have contributed to the transformation of traditional technology. Computer applications have made great contributions to the areas of improving product quality, lowering costs, improving work efficiency, as well as results, excellent products, and engineering designs, accelerating the renewal of products, and in promoting science management. According to calculations by the Planning Department of the Ministry of the Coal Industry and the actual practice of the Ministry of Water Resources and Electric Power, by using computer-aided design, funding can typically be reduced by 3-5 percent. The General Shipping Company uses computer systems to aid in the manufacture of ships, and everything from price quotations, signing agreements, design, manufacture, and inspection to paying and settling ship accounts is aided by computers. Just from reducing 1 or 2 months from the time of design alone, the general company reaped economic gains of 10 million yuan. The General Petroleum and Chemical Industrial Company used computers to transform the production and management system, economic results for which company were above 260 million yuan in 1985.

Second, initial results have been seen in overall national policy making and in management services. During the period of the "Sixth 5-Year Plan," the State Planning Commission and the State Bureau of Statistics each established databases for overall, energy, agriculture, population, personnel, and the basic conditions of medium and large core enterprises. They constructed economic and mathematic models for economic development forecasting and policy simulation, and they have provided a basis for formulation of policy and planning. During our third population survey, 40 billion characters and 1.2 billion records of data were handled. The computing center at the Ministry of Finance has used computers to do forecasts and comparisons of financial materials from 80,000 enterprises, the amount of work they have done being equal to that of 550 workers in a year, and they have provided a basis for overall policy making for the state's second phase of turning profits into taxes. The overall balance model developed by the Ministry of Astronautics for financial supplements, pricing, and wages has forecasted economic trends in overall market sales volumes and price levels for the last 3 years, which has contributed to calculating standards for vegetable supplements for the urban population. The State Supplies Bureau economic management information system in just the area of managing bearing products alone, reduced the warehouse storage quantities for the provisions organizations of various ministries and commissions by 30 percent from 1984 to 1985, cutting down funds in use by more than 200 million yuan.

Third, results have been outstanding for science and engineering data processing services. Relevant state science research organizations and higher institutions have brought in and developed linear and non-linear finite element analysis programs and three-dimensional graphics processing systems, which have been successfully used in major projects. Data processing for petroleum seismic well logging materials has reached international standards of the early 1980's. The numerical method for seismic processing that was researched by the Chinese Academy of Sciences is of great theoretical and practical value. The Ministry of the Petroleum Industry has used computers to handle seismic prospecting data and materials, which has allowed them to bring down the amount of funds needed for the verification of 100 million tons of petroleum reserves from the 790 million yuan of 1981 to the 320 million yuan of 1984. Using computers to evaluate well logging information has improved the rate of conformity by 27 percent over manual solutions, the economic results generated from this being 175 million yuan.

Fourth, they have played a very important role in national defense research and in major projects. Computer techniques such as scientific calculations, numerical simulations, emulation, and measurement have had important functions in building national defense and major project construction, as well as in developing high technology. For example, we have used computers that we have designed and manufactured to control nuclear fusion research, launching missiles into the Pacific and from beneath water, as well as for synchronous satellite positioning.

## Important Experiences in Applications

Dramatic focus on microcomputer applications is an important path by which to make breakthroughs in our computer applications.

Practice has shown that microcomputer applications are inexpensively financed, produce quick results, and are beneficial to the training of applications personnel. They are easy to operate and easy to disseminate within this country. Therefore, they are also useful for getting rid of the superstitions people have about computers, and for making the most of enthusiasm for using computers in all professions and industries. Disseminating applications based on microcomputers is extremely suited to our national conditions, and is one of the important reasons for attaining greater development in computer applications during the period of the "Sixth 5-Year Plan."

Dissemination and application of microcomputers has resulted in an accumulation of experience that has made necessary technical and methodological preparations for the full utilization of the hardware and software resources of non-microcomputers.

Dissemination of model demonstration industries is an effective method for the active but prudent development of computer applications, that deals with the complexities of computer applications, and is a scientific method that has come about in light of actual conditions in this country. The method that has resulted from a summation of the experiences of many areas and sectors is: 1, to proceed after an evaluation of strengths; 2, be familiar with the technology; 3, cater to production and obtaining results; 4, on the basis of experimental sites and after results have been obtained, then continue to disseminate progressively within particular fields or industries.

Enhancing software development and circulation control is the key to doing a good job with computer applications. The research and development of systems software and support software is the basis for universal applications in the dissemination of computer applications. Some departments and units have had outstanding results from joining together to bring about technical advantages and to concentrate development. Applications software have joined the areas of science research, education, the computer industry, and users, and have undertaken development based on the realities of professional applications. Many valuable achievements in dissemination have resulted from this, which have promoted the commercialization of software and have given impetus to applications.

Training personnel through the use of various channels and methods is an important path for expanding the computer applications contingent. To develop computer applications, we must build a technical contingent that is clear in hierarchy and fully equipped with hardware. Under the unified leadership of the State Education Commission, invoke the enthusiasm of all sectors, and train personnel through various channels and with various methods. In addition to formal education, many schools and applications departments have started various kinds of study classes that have trained a large number of applications personnel.

Based on actual conditions in this country, the integration of computer specialists with user specialists in other fields is a most positive factor in promoting computer applications. The combination of two kinds of talent and two kinds of knowledge suits our national condition, suits the requirements of knowledge intensiveness for computer applications, and suits the trends in international science and technology that develop toward a high degree of comprehensiveness. This kind of integration makes it easy to pool collective wisdom and develop new thinking, and provides preparations in the area of talent for developing a computer manufacturing industry and a computer servicing industry. It also plays an important promotional role in forming a Chinese information industry.

12586

CSO: 4008/1080

PERFORMANCE OF V-TYPE FLAMEHOLDER IN AFTERBURNER IMPROVED

Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 7, No 2, May 86 pp 179-181

[Article by Tan Haoyuan [6151 3185 0337] and Wang Jiahua [3769 1367 7520], Nanjing Aeronautical Institute: "A Test Research for Improving the Performance of V-Type Flameholder Used in an Afterburner"; this paper was read at the Fifth Academic Annual Meeting of the Chinese Engineering Physics Society held in Suzhou in 1985]

[Text] English Abstract: This research paper describes the V-type with gaps flameholder used in a jet engine afterburner. It was the result of model tests that the recovery coefficient of total pressure increased, the quenching limit for poor fuel extended and the combustion efficiency improved. The unit fuel consumption rate decreased about 1 percent under full scale engine tests.

I. Test Equipment

The test equipment was a low pressure combustion system with a total air flow of 1.4 kg/s. Fuel feed was in two locations: a fuel injection rod placed at the front about 3 meters from the holder, with the fuel accounting for 70 percent of the fuel volume, this fuel could completely evaporate; and a single centrifugal nozzle placed at the back which accounted for 30 percent of the fuel and since it was close to the holder, the fuel could not completely evaporate. This fuel feed method could approximate the actual fuel feed situation in an engine. The test section had two elements: height x width = 150 x 100 mm<sup>2</sup>. The test was to open gaps on the tops of conventional V-type holders to turn it into a simple preheating holder. The blockage ratio was 30 percent. The structure is as in Figure 1.

II. Model Test Results and Discussion

1. Losses due to flow resistance. In cold air tests, we measured the relationship of the holders' total pressure recovery coefficient number and the rate of flow M number, see Figure 2.  $\sigma_b = P_2^*/P_1^*$ .  $P_2^*$  is the total pressure of the front and back of the holder. Figure 2 gives the normal objective pattern. The total pressure recovery coefficient of the improved-type holders were higher than the conventional ones, and became higher with

increases in the gap width. The higher the speed, the greater the sensitivity of the gap width to the total recovery pressure coefficient. The total pressure recovery coefficient of a  $2\delta = 6$  mm holder when  $M = 0.2$ , increased 0.5 percent compared to the conventional V-type. This structure can be viewed as a combination of a small V-type holder and a pressure expander. As the gap increased, the blockage of the small holder diminished, therefore the losses diminished.

Holder Number	No. 1	No. 2	No. 3	No. 4
Gap width 2 $\delta$ mm	0	4.14	6.18	10.40

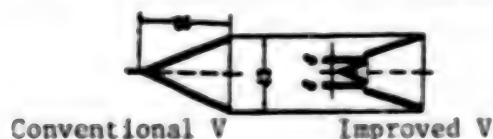


Figure 1. Flameholder Structure and Dimensions

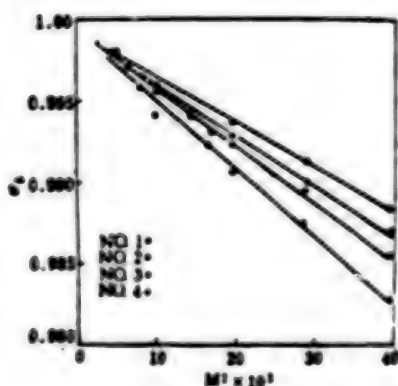


Figure 2. Relationship of Total Recovery Coefficient and M Number

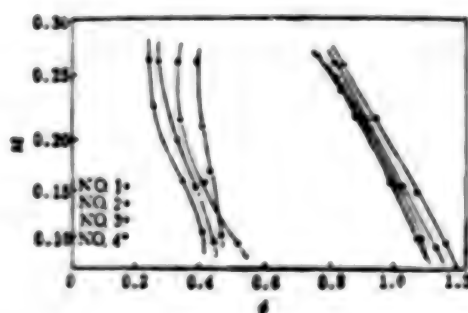


Figure 3. Graph of Quenching Limit

2. Stability. See Figure 3 for test results of the quenching of poor fuel-good fuel limit. When the M number increased, the poor fuel quenching limit grew wider; the poor fuel range of the improved type holder was broader than the original type, and in No 2 holder is even clearer. When  $M = 0.25$  the quenching limit expanded from  $\phi = 0.4$  to  $\phi = 0.25$ , an increase of approximately 37.5 percent. Since the back nozzle was closer to the holder, two phase mixed gases entered the holder. An increase in the M number helped atomizing. The two phase mixed gases enter the holder from the gaps, the fuel drops are concentrated in the backflow area and evaporate and burn which are characteristic of evaporation type holders and preheated type holders, therefore the quenching limit expanded. The No 4 holder's

$2\delta = 10.4$  mm, the preheated flow was too great, the backflow area contracted, and only the small holder played a role stabilizing the flame. Performance began to decline. On the good fuel limit, the range of the improved-type was contracted more than the original type, but the degree of contraction was not great. If  $M = 0.25$ , the good fuel quenching range dropped from  $\phi = 0.87$  to  $\phi = 0.81$ , a contraction of about 7 percent. This is because when the two phase flow evaporates in the holder, the ratio of some of the fuel and air surrounding the fuel drops is richer than in the conventional holder. Figure 4 shows that the good fuel quenching range becomes slightly narrower as the gap width increases but the range of the poor fuel quenching limit first expands as the gap increases, then contracts. Within the range of  $2\delta = 4-6$  mm the poor fuel quenching limit is optimum.

3. Combustion efficiency. The combustion efficiency of the holders with changes in the quantity ratio are as in Figure 5. The combustion efficiency of the improved holder was about 5 percent higher than that of the conventional one. These curves have the typical characteristics of evaporation-type holders. When the equivalent ratio is larger than a certain value (such as 0.63) then as the gaps become wider the volume of fuel which is not yet evaporated which has entered the holder increases and efficiency drops; conversely, when a large gap holder in  $\phi$  is relatively short, the combustion efficiency is higher. When  $\phi = 0.7$ , and  $2\delta$  is between 4 mm and 6 mm, the combustion efficiency is at its optimum value.

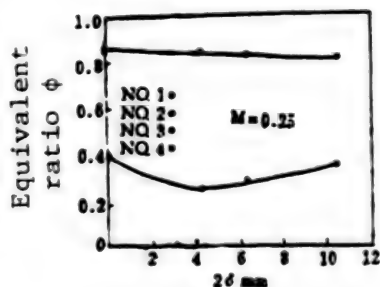


Figure 4. Quenching Limit With Changes in Gap Width

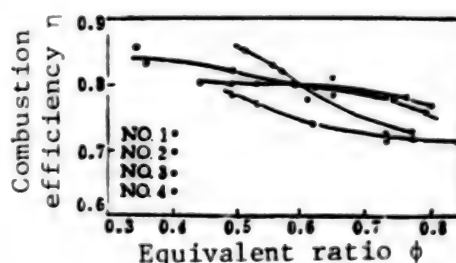


Figure 5. Relationship of Combustion Efficiency and Equivalent Ratio

### III. Bench Tests

A WP-6 engine was used for all dimension tests of the holder. No 11 holder's  $2\delta = 6$  mm and No 15's  $2\delta$  was 8 mm. Data on the comparison with the original type is listed in Table 1.  $dC$  is the difference between the engine's unit fuel consumption and the standard unit fuel consumption ( $dC = C_T - C_{\text{standard}}$ ),  $dR$  is the difference of engine measured thrust and the standard thrust. From the rated state we can see that when the thrusts are basically equivalent, No 11's holder unit fuel consumption drops 0.009 [kg of fuel/kg of thrust·hours]. The drop in No 15's test was even greater because the gaps were large and the loss due to flow resistance was small; the results of No 11's afterburning state were more satisfactory, thrust increased 35 kg,

fuel consumption dropped 0.009 [kg of fuel/kg of thrust·hours], because the better dimensions of the model test results were selected for this test. Afterburner thrust was about 3000 kg, therefore each engine could save 27 kg of fuel per hour. If the adjusted afterburner thrust is equivalent to the original model, fuel consumption can still be lowered. The relative gain in fuel consumption is about 1 percent. From the temperature indicating paint it was determined that the holder wall temperature was about 50°C lower than the original model. This is the result of gap air flow cooling which is beneficial for prolonging holder life.

Table 1. Comparison of Bench Test Results

Status	Original V-type			No.11			No.15		
	Rated	Max.	(1)	Rated	Max.	(1)	Rated	Max.	(1)
Meas. RPM	11155	11150	11155	11156	11143	11160	11150	11140	11155
$\Delta R(\Delta R)$ , kg	-7.5	-28	-15	-10 (-2.5)	-23.6 (+4.4)	20(+35)	-6(+1.5)	-38(-10)	25(+40)
$\Delta C(\Delta C)$ , kg/kghrs	-0.0105	-0.0210	-0.0907	-0.0195 (-0.009)	-0.0245 (-0.0035)	-0.0997 (-0.009)	-0.0291 (-0.0186)	-0.0238 (-0.0028)	-0.0902 (+0.0005)
$T_w, ^\circ C$	540	630	645	536.6	631.7	650	535	625	650
Jet dia. mm	480	451	508.5	473	448.5	506	473	448.5	506

Note: Fuel consumption gain  $\Delta C = dC_{\text{improved}} - dC_{\text{original}}$ ; thrust gain  $\Delta R = dR_{\text{improved}} - dR_{\text{original}}$

Key: (1) Afterburner

#### IV. Preliminary Conclusions

The flow resistance of the improved holder was lower than the original model. When M is 0.2, the overall pressure recovery coefficient increased 0.5 percent; the good fuel quenching limit contracted about 7 percent but the poor fuel quenching limit expanded about 37 percent; relative comparative combustion efficiency increased about 5 percent; optimum gap width  $2\delta$  was 4-6 mm; in engine bench tests, in rated and afterburner states it could lower unit fuel consumption about 1 percent.

The author expresses his profound thanks to Comrades Cao Guoming [2580 0948 0682], Wang Jigen [3769 4764 2704], Zhang Hongbin [1728 3163 6333], and Su Xianru [5685 0341 1172] who participated in the tests.

8226/6091

CSO: 4008/73

PRESSURIZED COMBUSTION TEST OF COAL-WATER MIXTURE AS GAS TURBINE FUEL

Beijing GONGCHENG REWULI XUEBAO [JOURNAL OF ENGINEERING THERMOPHYSICS] in Chinese Vol 7, No 2, May 86 pp 162-165

[Article by Gao Lijun [7559 7787 0689], Institute of Engineering Thermophysics, Chinese Academy of Sciences: "A Pressurized Combustion Test of Coal-Water Mixtures as a Fuel in Gas Turbine Combustor"; this paper was read at the Fifth Scientific Annual Meeting of the Chinese Engineering Physics Society held in Suzhou in 1985]

[Text] English Abstract: The purpose of this paper is to examine the feasibility of Ultra-Cleaned Coal-Water Mixture (UCCWM) as a fuel in a gas turbine combustor. Five kinds of UCCWM were used in pressurized combustion at  $4 \times 10^5$  Pa,  $7 \times 10^5$  Pa, and  $11 \times 10^5$  Pa. The effect of combustor pressure on combustion efficiency, distribution of temperature, particle size, ash deposition, and gas exhaust was discussed. A viability of using CWM in modified aero-engines is being evaluated under atmospheric pressure.

This paper treats the feasibility of using ultra-cleaned coal-water mixture in gas turbine combustors. The cleaning process of ultra-cleaned coal-water mixture should be higher than in boilers, the average dimensions of the particle bodies in the mixture is on the order of  $10 \mu\text{m}$ , ash and sulphur content is about 1 percent (by weight). This paper analyzes the pressurized combustion of five different ultra-cleaned coal-water mixtures at  $4 \times 10^5$  Pa,  $7 \times 10^5$  Pa, and  $11 \times 10^5$  Pa and emphasizes a discussion of the influence of pressure on combustion efficiency, wall temperature distribution, dimensions of particles in the exhaust gas, ash deposition, and gas exhaust, and describes the constant pressure combustion experiments using coal-water mixture made by Shandong's Datong Coal.

## I. Important Constituents and Characteristics of Ultra-Cleaned Coal-Water Mixture

Table 1. Constituents of Ultra-Cleaned Coal-Water Mixture

Mixture number	Elemental analysis (% by weight)						Water (% by weight)	Appx. analysis (% by weight)		
	Carbon	Hydro-gen	Oxygen	Nitro-gen	Acid	Ash		Vola-tile matter	Fixed carbon	Ash
S1	76.45	4.73	12.97	1.84	1.00	3.01	36.18	36.53	60.46	3.01
S2	77.61	4.91	13.35	2.19	1.26	0.68	39.01	36.75	62.57	0.68
S3	78.56	4.95	11.62	1.55	1.12	2.20	41.40	37.53	60.27	2.20
S4	82.44	5.12	8.53	1.62	0.91	1.38	37.96	--	--	--
S5	82.44	5.28	7.74	1.26	1.0	1.13	35.51	--	--	--

Table 2. Characteristics of Ultra-Cleaned Coal-Water Mixture

Mixture number	Viscosity (cp)	Shear rate ( $s^{-1}$ )	Maximum particle diameter ( $\mu m$ )	Average dia. of particle ( $\mu m$ )	Thermal value of coal (J/kg)
S1	889	2.5	40.3	5.27	$31 \times 10^6$
S2	3,340	1.5	32	7.11	$31.62 \times 10^6$
S3	331	2.5	40.32	6.12	$31.8 \times 10^6$
S4	--	--	--	--	--
S5	--	--	--	--	$34.33 \times 10^6$

## II. The Pressure Combustion Test System

1. Shipping the mixture: Before feeding, the mixture flowed by gravity from the storage tank to the pump and the pump also constantly forced the mixture into the storage tank so that it constantly circulated to obtain a good flow of the mixture. The volume of mixture flow was regulated by regulating the air pressure entering the tank. 2. Atomizer: An anti-equilibrium twin channel pneumatic nebulizer was used in the test for the atomizer. See Figure 1 for a diagram of the structure of the nozzle head. Air is the atomizing medium. To avoid blocking of the mixture, a straight mixture channel is placed in the center of the nozzle. The natural gas channel is for preheating the combustor. The rotational direction of the atomizing air is the reverse of the mixture flow rate. 3. Cyclone: In the tests we used a slider cyclone to provide primary swirling air. Primary air flowing from the adjustable channel accompanied by secondary swirling air in the

reverse direction intensified the mixture of air and mixture in the combustor and formed a violent backflow area which promoted the combustion process. The maximum vortex number corresponding to when the maximum adjustment angle is  $15^\circ$  is 1.37. The air was preheated to  $250^\circ\text{C}$ - $350^\circ\text{C}$ . Preheating the air promotes evaporation of the water in the coal-water mixture and thus promotes ignition and a stable flame. 4. Combustor: The combustor with refractory cement lined walls is illustrated in Figure 2. It is made up of a central cylinder with a high speed area. An electrospark ignition fires the natural gas and when the walls are preheated to  $1000^\circ\text{C}$ , the burning natural gas is replaced by burning coal-water mixture. The smoke goes through a high temperature control valve and a water-quenching ring then is released into the atmosphere by an exhaust fan. The exhaust temperature dropped to about  $150^\circ\text{C}$ . The combustor pressure relies on guarantees of inputting an air and coal mixture at a definite pressure and regulating the high temperature control valve of the exhaust system is the way in which stability of pressure is achieved. 5. Measurement system: A thermocouple was used to measure the combustor wall temperature. Combustion efficiency was determined by measuring the  $\text{CO}_2$  and  $\text{O}_2$  in the combustion product. A quench sampling tube was used to collect smoke and a counter was used to determine the dimensions of the particles in the smoke.

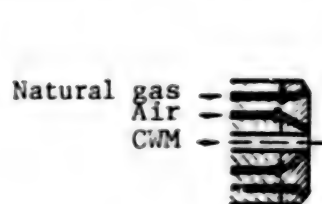


Figure 1. Atomizer Throat

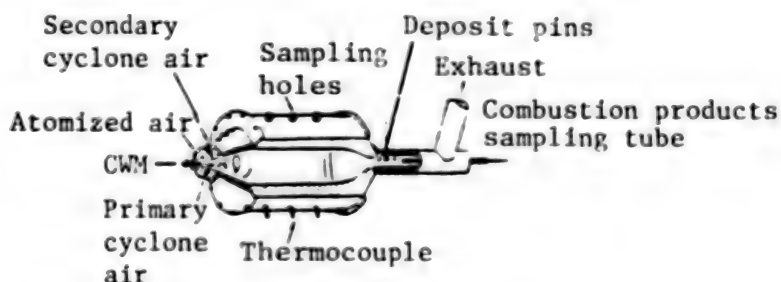


Figure 2. Combustor

### III. Main Test Results

The tests were carried out on the basis of a series of selected parameter tests. Test parameters chosen through analysis and comparison are as follows: coal mixture flow was 45 kg/h, the excess air coefficient was 25 percent, the mass/flow ratio of atomized air to coal mixture was 3, the primary air cyclone number was 1.37, the flow distribution ratio of primary cyclone air to secondary cyclone air was 1:1. The main test results are as follows:

1. Combustion efficiency: Generally speaking, when fuel at a definite mass flow and air at a definite mass flow is supplied at different pressures in a gas turbine combustor, the temperature in the combustor does not basically change, thus it is held that the mass flow rate of air is directly proportional to pressure, therefore when the pressure is high there should be a high flame density and combustion rate, and when the pressure is high the flame temperature should be higher than when the pressure is low.

After the fuel is ignited a high radiation temperature is created, therefore the particle surface also should have a high temperature, and generally speaking, combustion efficiency at high pressure is higher than at low pressure. But on the other hand as pressure increases, the convection heat transfer of the particle surface to the surrounding air also increases<sup>[2]</sup>, thus making the temperature of the particle surface lower, leading to a lowering of combustion as a whole. For burning the coal-water mixture, as pressure increases, reciprocal jietuan [4814 0957 aggregating?] of the particles is created thus reducing the overall combustion area which can also lead to lowering total combustion. The combustion efficiencies given in Figure 3 are average values. From the figure it can be seen that as pressure increases, the combustion efficiency is lowered, and when burning S4 mixture, the lowering of efficiency is most obvious. 2. Particles in the gas: Figure 4 gives the average diameter of the particle bodies in the smoke of different types of ultra-cleaned coal-water mixture at different pressures. The sampling tubes at positions #1, #2, and #3A(#3B) were located 13 cm, 33 cm and 53 cm, respectively from the combustion head flange surface. From the figure it can be seen that the diameter of most of the particles is between 10  $\mu\text{m}$  and 20  $\mu\text{m}$  and this value is larger than the diameter of the particles in the coal-water mixture. This is different from the situation of using constant pressure combustion of the same nozzle. At constant pressure, after the ultra-cleaned coal-water mixture has burned, the average diameter of the particles in the smoke is only one-half the average diameter of the particles in the coal mixture<sup>[3]</sup>, so it can be seen from this that as the combustor pressure increases, the small particles jietuan together. From Figure 4 it can also be seen that as the coal-water mixture viscosity increases, the particle dimensions also increased, for example, the particle diameters of mixtures S2 and S5 which had a viscosity of about 3000CP were larger than S4 which had a viscosity of 331CP. From the figure it can be seen that at different sampling positions the changes in particle dimensions were not uniform either, not only because of the pulsation of combustion, but also due to sampling chance rate, and although during the tests there were sampling tubes at different cross-sections, a single point sampling tube can only obtain a sample at one (or two) point(s) on each surface. 3. Temperature: Figure 5 shows that when burning different types of ultra-cleaned coal-water mixture, the combustor exit wall temperature reached over 1180°C. The rise in temperature again at the 7th point in the figure indicates that when burning the coal-water mixture the flame is elongated. Therefore, when designing the combustor, sufficient combustor length and displacement and good air flow should be considered to achieve even higher complete combustion and combustor exit temperatures. 4. Discharge of combustion products: Figure 6 shows that in the combustion product the range of SO<sub>2</sub> was 450-570 ppm, the range of NO<sub>x</sub> was 330-720 ppm. These values do not yet reach the U.S. national discharge standard. 5. Ash: The overall ash content in the combustor was low. For example, when burning S2 at  $4.2 \times 10^5$  Pa, the total amount of mixture fed was 86 kg, and after the test, 325 mg of ash were collected in the combustor, only 0.38 percent of the amount of mixture fed, therefore most of the ash was expelled with the smoke.

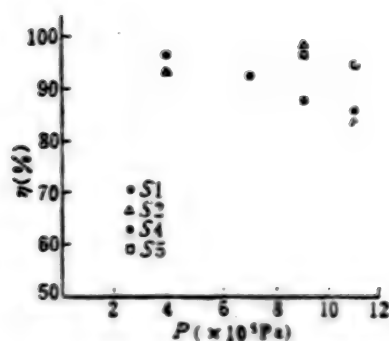


Figure 3. Combustor Efficiency

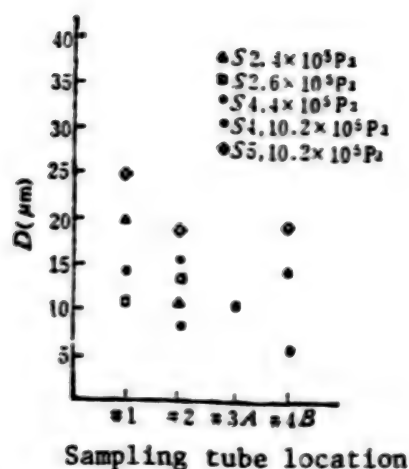


Figure 4. Average Diameter of Particle Bodies

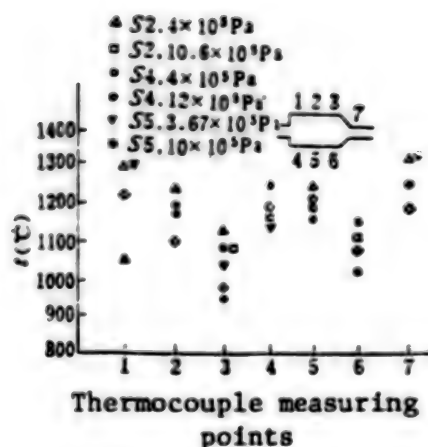


Figure 5. Wall Temperature

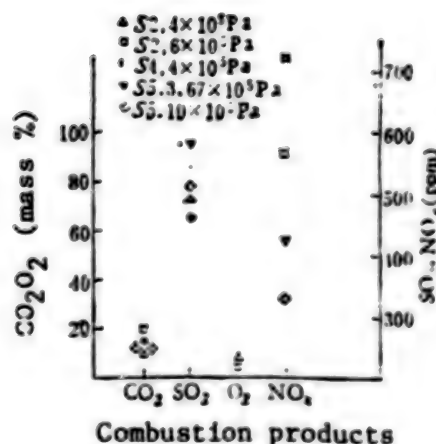


Figure 6. Composition of Combustion Products

#### IV. Constant Pressure Combustion Tests Carried Out in China\*

We first carried out constant pressure combustion tests of the application of coal-water mixture to gas turbines in China in 1984. The combustor was an improved WP-5 aero-engine combustor and a pneumatic nebulizer nozzle was used to replace the original pressure centrifugal nozzle; taking into account that the spray distance of burning the coal-water mixture was longer, the four exhaust holes in the front of the flame tube were sealed; to increase the radiation of the flame tube inner walls, they were sprayed with  $\text{Al}_2\text{O}_3$ . See Table 3 for the parameters used in the test. The test showed that when there was a small amount of auxiliary ignition methane flame present,

\*This work was carried out by the Application of Coal-Water Mixture to Gas Turbine Research Group of the Engineering Thermophysics Institute

the coal-water mixture could form torch stable combustion inside an improved aircraft gas turbine combustor. If we used oxygen as the injected gas in the nozzle, after the auxiliary ignition methane was cut off, a single coal-water mixture torch could maintain stable combustion. When the swirler was improved from the viewpoint of turbulence theory, we could see that the length in the flame area was clearly reduced, combustion intensity was increased, and at this time after the auxiliary ignition methane gas was cut off, the injection gas in the nozzle was switched from oxygen to air, and stable combustion by the single coal-water mixture torch was achieved in 16 minutes.

Table 3. Constant Pressure Combustion Test Parameters

Coal-water mixture flow	20 kg/h
Cold air flow	0.048 kg/s
Combustor inlet air temperature	873°C
Injected air flow	0.0017 m <sup>3</sup> /s
Injection methane gas flow	0.00034 m <sup>3</sup> /s
Supplemental air flow	0.0024 m <sup>3</sup> /s

## V. Conclusion

1. In the pressure combustion test bed with a heat tolerant layer adapter, when the nominal input heat was  $0.737 \times 10^9$  J/h, the pressure combustion tests showed that the use of ultra-cleaned coal-water mixture in gas turbine combustors is feasible. When the coal-water mixture is burned below  $12 \times 10^5$  Pa (meter pressure), most of the efficiency is above 90 percent. 2. When the excess air coefficient in the combustor is 1.2-1.4, the combustor outlet wall temperature reached more than 1180°C. 3. For the anti-equilibrium pneumatic nebulizer nozzle, when the atomized air ratio to coal mixture flow is 3, the pressure combustion tests indicated that the average diameter of the particle bodies in the smoke was between 10  $\mu$ m and 20  $\mu$ m, which value is larger than the diameter of the particles in the coal mixture. This indicates that at high pressure the particles jietuan together. 4. Although fairly stable combustion was achieved in the pressure combustion test bed, the discharge of SO<sub>2</sub> and NO<sub>x</sub> is not up to U.S. national standards. 5. Exploratory constant pressure tests of burning coal-water mixture carried out in China in light structure improved gas turbine aero-engine combustors similarly proved the feasibility of burning coal-water mixture in gas turbines.

## REFERENCES

- [1] Wang Yingshi et al., "A Thermodynamic Analysis of the Gas Turbine/Steam Turbine Combine Cycle With CWS as Fuel," Proc. of 5th Int. Symposium on Coal Slurry Comb and Tech., (1983).
- [2] T.T. Omori and A.A. Orning: "Effect of Pressure on the Combustion of Pulverized Coal," ASME Transaction, 72, (1950).
- [3] Debbie M. Davis-Watermire and Rodney J. Anderson: "Combustion Research Related to Utilization of Coal as Turbine Fuel," METC Research Paper, (1983).

8226/6091

CSO: 4008/73

## SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

### LIAOWANG HAILS ATOMIC BOMB SPECIALIST DENG JIAXIAN

HK100930 Beijing LIAOWANG in Chinese No 25, 23 Jun 86 pp 4-8

[Article by LIAOWANG reporter Gu Mainan [7357 6701 0589]: "Deng Jiaxian, a Man of Great Merit in Developing the 'Two Bombs'"]

[Text] Many scientists of the older generation still remember that for some time during the 1940's, a number of outstanding nuclear physicists in the world "disappeared" all of a sudden. And they did not reappear in public until the successful explosion of the first U.S. atom bomb.

Scientists "disappeared" in China, too. Not long ago, Professor Yang Chen Ning asked a 1960's nuclear physics graduate at Beijing University: "Have you ever heard of Deng Jiaxian?" The latter shook his head. We cannot blame that graduate for his ignorance. This is because Deng Jiaxian had for a time engaged in some kind of top secret work for the state.

This reporter has of late covered China's nuclear weaponry research and design base, and has learned much about the heartbreaking stories of Deng Jiaxian and many other unknown heroes, who have dedicated their whole lives to consolidating China's national defense.

#### We Shall Launch a "Big Firecracker"

We will go back to autumn 1958. A responsible person of the Second Ministry of Machine-building at that time sent for Deng Jiaxian and said: "Deng, we shall fire a 'big fire-cracker.' This is a top secret matter, and we should like you to join in the work. What do you think of it?" He said solemnly: "This is a glorious task!"

Deng Jiaxian had been to the United States before the founding of the PRC, shortly after his graduation from the Department of Physics, Southwest Union University, Kunming. After he acquired his doctorate degree at Purdue University, Indiana in 1950, he overcame one obstruction after another and returned to China with another 200 or more Chinese students studying abroad. When this young doctor appeared before the older generation physicists who had just returned from Europe and the United States, such as Qian Sanqiang, Peng Yuanwu, and Wang Ganchang, everybody was happy to have such young blood at the newly set up Modern Physics

Institute for Research under the Chinese Academy of Sciences. For several years, Deng Jiaxian worked hard together with the veteran scientists in initiating the undertaking. They rode their bicycles to purchase parts at some stalls selling secondhand goods, and made the Modern Physics Institute--the first research organ of modern physics in new China--gradually grow.

When the responsible person in China's nuclear industry said that China was to launch a "big firecracker," and that Deng was to join in the work, Deng instantly understood that he was being asked to take part in the research and development of the atom bomb. Facing this matter of great importance as well as arduous and glorious, he was rather terrified and timid, and said: "Developing the atomic bomb! But, am I up to the requirements for the job?"

"Sure, you are. Do it together with the others! This is the nation's trust in you. The whole thing has a bearing on the security or danger to the state; I believe you will make a good job of it!"

When Deng went home that evening, he could not sleep all night. His wife, Xu Luxi found this extraordinary and asked him what had happened?

"No big deal, only I'll be transferred to another post!" he said quietly, but when he thought that it would be impossible to stay together with his wife and children most of the year round, he was a bit sad. With deep regret, he said: "Luxi, I'm afraid I shan't be able to take good care of our day-to-day family life from now on. My life will be dedicated to my future work. If I do a good job of it, my whole life will be quite significant, and it is even worthwhile if I die for it!"

That night, Deng and his wife recalled many things in the past, talked about the experiences they had shared and the future of the nation, and both of them became emotional. His wife Luxi, the eldest daughter of Mr Xu Deyan, knew nothing about where Deng would be transferred, nor what kind of job he would be engaged in. She saw that the undertaking her husband would go in for would be an important one that had a bearing on the state's interests, and believed that her husband would go all out without regard for his own life. That was because they had both experienced national disasters and the ruin of their families...the gunfire of the Japanese invaders at Lugougiao in the 'July 7 incident' in particular seemed to be still echoing in their ears, and how often did the scenes of Japanese soldiers arbitrarily slaughtering unarmed Chinese come back before their eyes...

"A nation without the strength of self-defense will inevitably be knifed, and its people will suffer." Since the "July 7 incident" Deng had to begin a life in exile with his teachers and schoolmates. Now, when he learned that China, a backward country which had been bullied arbitrarily was going to develop a strategic nuclear weapon in order to consolidate its national defense he could not repress the excitement and joy in his heart. Since then, this excellent young physicist, who had already caught the attention of the public both at home and abroad, receded totally into oblivion.

## Years of Hardship Initiating the Undertaking

After his "disappearance," Deng Jiaxian entered the Nuclear Weaponry Research and Design Institute in preparation. The so-called Nuclear Weaponry Research and Design Institute at that time was simply a stretch of farmland, and its scientists and technicians were few in number. As responsible person for the theoretical design of the atom bomb, he had to start everything from scratch. The first thing he did after he took office was to change into his overalls, and to work together with the construction workers, cutting down kaoliang, building earth works, pushing carts, mixing mud, and building houses. He worked side by side with young people in mud and water. College students admired this hard-working man with a doctorate degree from a university abroad. When they saw him work clumsily, with his tall and broad physique, they found this funny and nicknamed him "the bear," and forgot about his official title. It was very busy at the work site; and the scientists and technicians were sweating all over. As days went by, one building after another was erected for the research center and workshops.

Prior to this, Marshall Nie Rongzhen had signed an accord on behalf of the Chinese Government on new national defense technology with the Soviet Union. According to the accord, the Soviet Union promised to provide China with an atom bomb model for teaching purposes. They had done a lot of work for the exhibition of this model, and sent people to the station for its delivery on several occasions, but the model never appeared.

One day, Liu Jie, the vice minister of the Second Engineering Building Ministry sent for [Deng Jiaxian] and said: "You must be mentally prepared; we must rely on ourselves for the theoretical design of the atom bomb."

That happened in the late 1950's.

"The research and development of a strategic nuclear weapon is where the interests of the Chinese and the world's peoples lie; now we have to rely on ourselves!" He was addressing the young college students. He encouraged the young people around him by saying: "People like us who are engaged in this undertaking should willingly become unknown heroes. We should not care about fame, nor personal benefits, but we must bear hardships. Even your fruits of scientific research are not to be published as theses."

If the atom bomb is compared to a dragon, the theoretical design of the atom bomb will be "the dragon head." According to a saying by the leading member of that time: The cubic equation for "the dragon head" is "the dragon head" of "the dragon head" of "the dragon head." The result of this leading work had a bearing on the success of all kinds of engineering design of the atom bomb. None of the Chinese had ever built an atom bomb before, and there was no authority to speak of in this field. Under the conditions of the strict blockade abroad, Deng studied hard, and prepared his lessons before giving lectures. The young people called him Professor Deng, but he said: "No don't do that, let's work together!" Sometimes,

he had to prepare his lessons until four in the morning, and he would take a rest in the office for 2 or 3 hours, then resume his work at daybreak. In the evening, the college students would all come to the office to study, but Deng would work until the others would stop their studying, despite the fact that his wife and children were waiting for him. Often he would go home on his bicycle under the escort of young people in the still of the night. Then, the gate to the barbed wire compound of his living quarters was closed, and he would climb over the barbed wire fence, and the young people would pass the bicycle to him over the fence. When he got home, he would find his wife working in the office on the evening shift, and his son asleep in the corridor... In those days, his whole energy was devoted to his work. Day in and day out, he would be in a trance, and he would think of the atom bomb even when he was walking. He worked so untiringly that many "jokes" about him circulated among those around him. One evening, they had some urgent task to complete, and when it was finally done, he said to one of his comrades, "Come, let's have a meal at my place!" When they had supper, the guest found the noodles had turned into some kind of gruel. His son had put the noodles in cold water before he put the pot on the fire!

"I'm sorry, that's my child's cooking," Deng said apologetically. Because his wife was working heart and soul in the office, their child had to do all the cooking. A primary school pupil of 12, his son had already undertaken all the household chores including preparing all the family meals.

Usually, he would never give orders to others at work, but just pat their shoulders and say: "Well, I'll have to rely on you for this, please do a good job of it." In those days, he worked overtime almost every night till midnight. Several years went by and in his planned work schedule, Sundays were always included as workdays. He had a familiar way with young people, being together with them all the time. He showed a great concern for others and was always untiring in his work. When it was at 1930 on Sundays, he would say: "All right, let's call it a day; it's time for you to go home and take care of your family affairs."

Nothing is too difficult to accomplish in this world. Deng Jiaxian and the others worked day and night, and by 1959, they had outlined the theoretical calculation of China's first atom bomb. In a series of key questions, such as explosive dynamics, neutron conveyance, nuclear reaction, the properties of material under high temperature and pressure, all kinds of scientific data had been worked out in a down-to-earth way, with no margin for error. China had none of the large-type electronic computers at that time. In order to get to the bottom of a problem, he once led more than 10 young people working on it continuously in three shifts day and night. Nine times they worked on the calculation with the help of four hand-operated calculators. Even working so meticulously, they were not satisfied with the results, and they invited such specialists in theoretical physics as Zhou Guang to make their estimation based on physical conceptions. The results proved that Deng's scientific data was accurate and sound.

At 1500 on 16 October 1964, a fiery mushroom-shaped cloud rose with a boom in the sky above the vast Gobi Desert. This thunder which shocked the world proclaimed: The age when the Chinese people were bullied arbitrarily had come to an end!

Later, a reporter of Chinese origin living abroad wrote, saying: "When news of the successful trial explosion of China's first atomic bomb spread abroad, the ecstasy and pride of the Chinese people was beyond description. In the eyes of overseas Chinese, that mushroom-shaped explosion was the full bloom of the spiritual flower of the Chinese nation. And the news spread from the newspapers and radio broadcasts was the letter from home worth a thousand gold pieces."

The spiritual flower of the Chinese nation in full bloom was precisely cultivated by Professor Deng Jiaxian and thousands upon thousands of ordinary Chinese people; and the letter from home worth a thousand gold pieces was written in the skies with the sweat and blood of a large number of unknown heroes.

**This Is the Battlefield, I Won't Leave!**

Shortly after the successful explosion of the first atom bomb, when Deng Jiaxian's thrill had not been pacified, another job with still greater difficulties fell on his shoulders, as well as those of other scientists and technicians.

This was another job requiring arduous labor. As responsible person for organizing the theoretical design in the development of the H-bomb, the difficulties he met with were unimaginable. In winter 1965, the research and development of the H-bomb was at its critical juncture. Once in the still of the night the guard was still standing by the door of the computer workshop. People asked why he did not go to sleep, and he answered he was there "to stand guard for Lao Deng."

"I'm sure he is not going home tonight. We'll take care of him, and you had better go to bed." Deng spent the whole night in the workshop that night, and he did not leave the place until he got the results. Day in and day out, he never stopped for a moment in his work. Sometimes, he would just take a rest on the floor of the workshop. He was under constant stress, experiencing one success or failure after another and crucial moments of life and death together with his colleagues. Particularly after he was appointed director of the Nuclear Weaponry Research and Design Institute, he had always played an exemplary role, been bold at taking risks, and exerted all his efforts.

Nuclear weapon technology has always been an absolute top secret with the superpowers. It is impossible to get it through such channels as import and exchange, and it is unavailable no matter what amount of foreign currencies we have. Under the arduous and difficult conditions in China, the Chinese wanted to master these technologies with their own wisdom and

hands. Aside from necessary support from the party and state, Deng Jiaxian and the other scientists who participated directly in the research and development of the nuclear bombs, have paid a tremendous price beyond imagination for it.

"As an organizer and participant in the course of the research and development of the H-bomb and new strategic nuclear weapons, Deng is a man of great merit!" Deng's colleagues said in unison. Every important breakthrough in the development of new strategic nuclear weapons, and every successful milestone test is linked with Deng Jiaxian's name, they said. All year round, he was going from one place to another, going where the difficulties were, appearing at the posts where the work was most dangerous, in the workshops for special material processing, at the dynamic physical test ground, in the wilderness in snowstorms.

It was well after midnight one day and he had already gone to bed. The nuclear material processing workshop faraway suddenly called him on the phone; a problem had cropped up in the processing of a key part. He put down the phone, said nothing, and got into a car still in his slippers. At that time, he was close to 60. He drove the car at top speed on the rugged valley roads in complete darkness for more than 3 hours, and it was almost daybreak when he finally arrived at his destination. He did not take a moment's rest, and ran straight into the workshop which processed the nuclear material. A worker who persisted in his work despite his illness was greatly comforted when he saw the director on the site, who made light of all the hardships in getting there. Deng studied the problem together with the workers, and soon solved it.

As director and one who takes the lead among scientists and technicians, his every word and action in his personal appearances at critical moments was unforgettable and comforting to those under his leadership. Now, all the parts of the nuclear device had been prepared, and the general assembly work was to begin. The assembly hall was completely quiet, scientists and technicians would come in, each to his own assembly post. Deng Jiaxian held the hand of one of the technicians. "But, why is your hand so cold? Come, let me warm it for you," Deng said, and put his hand inside his coat. "There's no hurry; we have ample time!" The scientists and technicians understood his appearance at every critical moment, which needed no explanation: "Should anything happen, we'll die together!"

When they worked, the scientists and technicians always bore Deng's words in mind: "There must be a weight to make the balance work! Nothing is a trifle here. Everything is important here. Any small problem will bring a disaster if not properly solved." Therefore, he always repeatedly asked everybody: "Any more problems?" And he would not accept even the smallest hidden danger.

One day, in the workshop in which the nuclear device was to be stored at the test base, a technicians noticed a spark when positioning the crane which was to lift the nuclear device. It was already 5:00 in the morning and Deng had only gone to bed a little earlier because he had worked well

past midnight. Learning about the situation, he hurried to the site. But no matter how hard they tried in testing, the spark did not show again. He then decided to set up a specialized group to get to the bottom of the problem. When the technician saw that the director was serious and concerned about the problem, he became all the more energetic in his work, and got all the records concerned ready, examining every entry on who had been there, and what had been moved. The search for the cause did not end until past 1600 that afternoon when it was eventually pinned down.

Year in and year out, he led scientists and technicians in the bitter struggle of research and nuclear testing at the forefront, working selflessly, and spent a whole decade living alone without the company of his wife and children. The risks of failure, the joys of success, working in the open under attack from storms and frost, had turned his sideburns white, and his face was marked with deep wrinkles. However, a tremendous success almost cost him his life through over excitement.

This was during an underground nuclear test. Everything was ready, and all the people at the test ground were waiting for the solemn countdown to "zero." The nuclear device was slowly going down the shaft, and all testing devices were set to work, monitoring whether or not all kinds of scientific data were normal, but when the nuclear device was sent deep into the shaft, a signal on one of the testing devices failed to work.

"What are we to do?" The scientists and technicians returned to the tents, trying to find a way out. Some suggested taking the nuclear device from the shaft to make a thorough examination; others believed this to be too dangerous, and they were for continuing to send the device lower down the shaft when the problem was solved. Thus the discussion went on from midnight till dawn. Finally, having compared all suggestions, Deng decided to adopt appropriate measures on the site. Together with the scientists and technicians, Deng arrived in the neighborhood of the shaft, and studied a solution for the problem. The wind was howling over the Gobi Desert, and it was piercing cold, for the temperature was  $-30^{\circ}\text{C}$ ! People found him exhausted, and said: "Director Deng, you had better go home!"

"No, here is the battlefield, I can't leave it!" Deng refused solemnly.

He did not leave the site until the trouble was ended. When the successful test was over, a celebration of the occasion was held, but he passed out after he drank just a small glass of wine in all his excitement, because he had not been eating regularly. Those at the scene laid him down hurriedly, and when his blood pressure was tested, it was shown to be very low.

"Director Deng! Director Deng...." People were calling his name, but he was still in a coma. He only opened his eyes after the doctors had applied first-aid throughout the night.

When he came to, the first thing he asked about was: What was the result of the nuclear explosion test? Was all the data ready? He just would not take a rest, and plunged into intense work.

## Utter Loyalty to the Motherland

Of the 32 nuclear tests China has conducted, Deng Jiaxian has on 15 occasions been personally in charge of command in the test team headquarters. During this period, he was often on a tight schedule, going straight from the railway station to the airport. Sometimes, there was not even time for a normal meal, and he had to get some steamed bread from the canteen and start for the journey. Within the period of a month one year, he made two round trips from the factory to the test site, a distance of several thousand km! More often than not he would get straight to work the moment he stepped out of the plane. It was always between 3 and 4 hours sleep at night, and he would often work all night through. Sometimes, having just gone to bed, after a telephone call he would put on his clothes again and set out to work.

The tense work over long years impaired his health, but he totally ignored it. He passed out on the test ground on several occasions. Once, before a nuclear test was to take place in winter 1984, he started for the test ground, dragging his legs along with some difficulty on the snow-covered earth. Suddenly, he found himself unable to go on any longer, and said to the two scientists walking in front of him: "Give me a hand, please give me a hand!" So saying, he fell upon the shoulders of the two men breathlessly. It turned out that he had stomach trouble, and an attack of hypoglycemia. He was extremely weak, but he continued working after he had taken some candies and water.

When a breakthrough was made in H-bomb theory, he would be as happy as a child with every success of the nuclear test. At such moments, he would take cigarettes and candies from his pockets, and say with smiles: "I'll stand you a treat today!" And if circumstances permitted, he would invite everyone to dinner.

But Deng Jiaxian was always very strict on himself. People say, as a famous scientist and leading cadre, his daughter was the last to return to the urban areas from Nei Monggol, settling down there in the countryside. For years, whenever he returned to Beijing from the research and test base, he would always buy a bus ticket with money from his own pocket, and he would take the bus when he was out on business. Once, he went to visit his wife, who was then confined to a hospital. On his way home, he was caught in a shower without even an umbrella. When he got home from the bus stop, he was wet through. When asked why he had not taken the car specially provided for him, he said: "I am a communist, I shouldn't enjoy special privileges when dealing with my personal affairs."

Shortly before a nuclear test in late January 1984, Deng Jiaxian took several scientists and technicians along with him to report their work condition to Beijing. In another 2 days, he would have to fly back to the test site. At that time, the airplane fare happened to rise. When he learned that the difference in prices between front and back cabins would be 40 yuan, he told the others to book him a seat at the back cabin. He said: "Let's save as much as we can for the state!"

"Deng, with your academic level and experiences, it is entirely possible for you to make your life a bit more comfortable. You can travel at home and abroad and see the world, giving lectures and touring places. Why should you have selected such a path and willingly struggle on such an arduous post?" an engineer asked him when they were having a conference in Hangzhou.

"Yes, the West Lake is so beautiful! It seems that it's the first time that I have ever visited Hangzhou. I have never imagined that it could be so beautiful. It's surely a wonderful thing to see places. But, a person should always do more for the people!" he answered, viewing the fascinating West Lake scene.

When touring the tomb of Yue Fei, he purposely stood in front of the stone tablet with the inscription "Utter Loyalty to the Motherland," and said to his comrades: "Come, please take a picture of me here."

And that is Deng Jiaxian, a man who has dedicated his whole life to the motherland, a man who has written a new song of "Utter Loyalty to the Motherland" with his own life.

China's intellectuals are worthy of the pride of the Chinese nation. This is because thousands upon thousands of people like Deng Jiaxian are engaged in bitter struggle in oblivion, to rejuvenate the Chinese nation, seeking neither fame nor personal interests.

/9604

CSO: 4008/83

GENERALIZED STEINER PROBLEM AND HEXAGONAL COORDINATE SYSTEM

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese  
Vol 8, No 4, Oct 85 pp 383-397

[English abstract of article by Weng Jiafeng [5040 4471 0023] of Baoshan General Iron and Steel Works, Shanghai]

[Text] The Steiner Problem is to construct a graph, which covers a set of given points and has minimal length. If some given points are not fixed, but constrained in some regions, the correspondent problem is called Generalized Steiner Problem. In this paper we develop a new coordinate system--Hexagonal coordinate System, and hence obtain an analytical method for solving Steiner problem and its generalized form. (Paper received 17 Aug 81, finalized 17 May 84)

REFERENCES

- [1] E. J. Cockayne, On the Steiner Problem, *Can. Math. Bull.*, 10: 3(1967), 431-450.
- [2] E. N. Gilbert and H. O. Pollak, Steiner Minimal Trees, *SIAM J. Appl. Math.*, 16: 1(1968), 1-29.
- [3] S. K. Chang, The Generation of Minimal Trees with a Steiner Topology, *J. Assoc. Comput. Mach.*, 19: 4(1972), 699-711.
- [4] Z. A. Melzak, On the Problem of Steiner, *Can. Math. Bull.*, 4(1961), 143-148.
- [5] E. J. Cockayne, On the Efficiency of Algorithm for Steiner Minimal Trees, *SIAM J. Appl. Math.*, 18: 1(1970), 150-159.
- [6] M. R. Garey, R. L. Graham and D. S. Johnson, The Complexity of Computing Steiner Minimal Trees, *SIAM J. Appl. Math.*, 32: 4(1977), 835-859.
- [7] 翁稼丰, 正多边形顶点集上的斯坦纳最小树, 待发表.
- [8] R. Courant and H. Robbins, *What is Mathematics?*, Oxford Univ. Press, London, 1946.
- [9] 陈国先, 带(直线)约束时两点间最短连线, 数学的认识与实践, 4(1980), 1-8.

# AN ENUMERATION FORMULA FOR SEQUENCES WITH A GIVEN NUMBER OF RUNS

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese  
Vol 8, No 4, Oct 85 pp 460-466

[English abstract of article by Ke Xin [2688 2946] of Qinghua University]

[Text] Consider sequences with  $m_i$   $i$ 's ( $1 \leq i \leq k$ ). The theory of Mobius inversion is used to give a general solution formula for the sequences which have a certain number of runs. Specific formulas for some special cases are derived. (Paper received 17 Dec 83.)

## REFERENCES

- [1] 张忠辅, 蔡茂诚, 林治勋, 关于连贯的计数问题, 应用数学学报, 5:3(1982), 285-290.
- [2] 钟秉, 有给定连贯数的序列的计数问题, 华南师院学报(自然科学版), 2(1982), 1-8
- [3] 屠建彰, 组合计数方法及其应用, 科学出版社, 北京, 1981 年.
- [4] 徐利治, 蔡茂森, 朱自强, 计算组合数学, 上海科学技术出版社, 1983 年.

# THE VARIATIONAL PROBLEM FOR THE BOUSSINESQ EQUATION AND RELATED BACKLUND TRANSFORMATION AND SOLITON SOLUTION

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese  
Vol 8, No 4, Oct 85 pp 482-488

[English abstract of article by Cheng Ansheng [2052 1344 3932] of Shanghai Institute of Computing Technology]

[Text] A Backlund transformation for the Boussinesq equation is obtained. We consider the divergence due to the Lagrangian and the condition of the simple Backlund transformation, thus deriving a number of relations with many parameters that may be restricted to certain values. For example, taking some suitable values, we can produce a Backlund transformation which accords with the result given in [3]. Similarly, given corresponding conditions, the soliton solution made in [3] will be a special case of our result. (Paper received 22 Dec 83.)

## REFERENCES

- [1] Hanno Rund. Variational problems and Backlund transformations associated with the Sine-Gordon and Korteweg-DeVries equations and their extensions. Backlund transformation. (R. M. Miura, ed) Springer-Verlag, 1974, 194—226.
- [2] Hsing-Hen Chen. Relation between Backlund transformations and inverse scattering problems. Backlund transformations. (R. M. Miura, ed) Springer-Verlag, 1974, 241—252.
- [3] 屠维彰, Boussinesq 方程的 Backlund 变换与守恒律. 应用数学学报, 4: 1(1981), 63—68.
- [4] George, M. Murphy. Ordinary differential equations and their solutions. D. van Nostrand Company (Canada), Ltd. 1960.

## THE SPACE $H^2$ OF ANALYTIC FUNCTION VECTORS

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese  
Vol 8, No 4, Oct 85 pp 498-504

[English abstract of article by Ni Zhongren [0242 1813 0088] of Beijing University]

[Text] Beurling described in 1949 all the invariant subspaces for the operator "multiplication by  $z$ " on the Hilbert space  $H^2$  of analytic functions in the unit disc. Let  $H^2$  be the space composed of analytic functions of class  $H^2$  in the unit disc,  $S$  be a non-trivial closed subspace of  $H^2$ , and  $z$  be a complex variable. Beurling obtained the following conclusions:

- (1)  $zS \subset S$  if and only if  $S$  has the form  $S=F(z)H^2$ , where  $F(z)$  is an inner function;
- (2) when  $S=F(z)H^2$ ,  $F(a)$  is the greatest common divisor of the inner parts of the functions in  $S$ ;
- (3) let  $h(z)$  be a function in  $H^2$ . Then  $z^n h(z)$ ,  $n=0, 1, 2, \dots$  span  $H^2$  if and only if  $h(z)$  is an outer function.

In this paper, Beurling's conclusions have been expanded to the spaces of analytic function vectors. (Paper received 29 Mar 84.)

### REFERENCES

- [1] E. Hoffman, *Banach spaces of analytic functions*, 1962.
- [2] И. П. 郭汤松著, 徐瑞云译, 实变函数论(下册), 人民教育出版社, 北京, 1958年12月.
- [3] И. И. 普里瓦洛夫著, 吴崇仁译, 解析函数的边界性质, 科学出版社, 北京, 1956年.
- [4] Ю. А. Романов, Спектральные свойства многомерных процессов и граничные свойства аналитических матриц, *Теор. Вероят. и её примен.* V, 4 (1960), 399—414.
- [5] G. H. 哈代, W. W. 洛戈辛斯基著, 徐瑞云、王斯雷译, 富里哀级数, 上海科技出版社, 1978.
- [6] В. И. Крылов, О функциях, регулярных в полуплоскости, *Матем. сб.*, 6 (48) (1939), 95—138.

## METHODS OF CALCULATING HOE AND THE TEST RESULTS

Tianjin TIANJIN DAXUE XUEBAO [JOURNAL OF TIANJIN UNIVERSITY] in Chinese No 1, Jan 86 pp 100-106

[English abstract of article by Wang Yongshao [3769 3057 2507], et al., of Department of Precision Instruments Tianjin University Tianjin, China]

[Text] This paper presents two methods of calculating HOE between the spherical wavefronts, and elliptical Gaussian and spherical wavefront. The test results obtained in computer-generated holograms are given, too. (Paper received 19 Oct 84.)

## REFERENCES

- [ 1 ] A.W. Lohmann, D.P. Paris, Appl. Opt. 6,1739(1967).
- [ 2 ] J. Pastor, Appl. Opt. 8, 525(1969).
- [ 3 ] C.S.Ih, Appl. Opt. 17,748(1978).
- [ 4 ] C.S.Ih, 王永刚 "Computer generated HOE for injection laser" ,1982 Annual meeting of the Optical Society of America.

/7358

CSO: 4009/1057

## THEORY AND APPLICATIONS OF RANDOM OPERATORS IN PROBABILISTIC METRIC SPACES

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese  
Vol 9, No 2, Apr 86 pp 129-137

[English abstract of article by Zhang Shisheng [1728 4258 3932] of Sichuan University]

[Text] The theory of random operators on a special class of probabilistic metric space, E-space, is considered. As an application, we utilize the results obtained to study the existence and uniqueness of random solutions of nonlinear random operator equations and of the system of nonlinear random operator equations. (Paper received 13 Apr 83.)

### REFERENCES

- [1] 游兆永, 概率度量空间压缩映象的拟 Picard 迭代收敛性定理, 数学研究与评论, 创刊号(1981), 25—28.
- [2] 王梓坤, 随机泛函分析引论, 数学进展, 5: 1(1962), 45—71.
- [3] 林 熙, 一类概率赋范线性空间与随机算子, 科学通报, 4(1983), 199—201.
- [4] V. M. Sehgal, A. T. Bhasucha-Reid, Fixed Points of Contraction Mappings on Probabilistic Metric Spaces, *Math. Systems Theory*, 6; 2(1972), 97—102.
- [5] C. A. Drossos, Stochastic Menger Spaces and Convergence in Probability, *Revue Roumaine Math. Pures et Appl.* Tome 22; 8(1977), 1069—1076.
- [6] K. Menger, Statistical Metrics, *Proc. Nat. Acad. Sci. USA*, 28(1942), 535—537.
- [7] B. Schweizer, A. Sklar, Statistical metric spaces, *Pacific J. Math.*, 10(1960), 313—334.
- [8] H. Sherwood, On E-Spaces and Their Relation to Other Classes of Probabilistic Metric Spaces, *J. London Math. Soc.*, 44(1969), 441—448.
- [9] H. Sherwood, On the Completion of Probabilistic Metric Space, *Z. Wahrscheinlichkeitstheorie Verw. Gebiete*, 6(1966), 62—64.
- [10] A. N. Serstnev, The notion of random normed space, *Dokl. Acad. Nauk, U. S. S. R.*, 149(2) (1963), 280—283.
- [11] Gh. Bocsan, On some fixed point theorems in random normed spaces, *Proc. 5th Conf. On Probability Theory* (1974), 153—155.

## A FAST ALGORITHM OF POLYNOMIAL REGRESSION

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 2, Apr 86 pp 146-153

[English abstract of article by Huang Junqin [7806 0193 2953] and Liu Zhengshe [0491 2419 4357] of Beijing Institute of Aeronautics and Astronautics]

[Text] A fast algorithm of polynomial regression is established as a result of improving the Householder's solution for overdetermined equations while keeping its high-accuracy characteristics. The algorithm can determine the order of a polynomial model and give the least squares estimate of the model parameters. If the order of the model is  $n$  the computational time is only equal to that of the solution of an  $n$ th order overdetermined equation, much less than the existing methods. (Paper received 12 Sep 83.)

### REFERENCES

- [1] 南京大学数学系计算数学专业, 概率统计基础和概率统计方法, 科学出版社, 北京, 1979, 228—233.
- [2] S. Haykin, Nonlinear Methods of Spectral Analysis, Springer-Verlag Berlin Heidelberg, New York, 1979, 41—48.
- [3] 黄俊钦、张楚志, 一种同时辨识模型阶次和参数的方法, 仪器仪表学报, 5: 4(1984), 339—345.
- [4] 黄俊钦, 测试误差分析与数学模型, 国防工业出版社, 北京, 1985, 195—208.
- [5] 冯康等, 数值计算方法, 国防工业出版社, 北京, 1978, 255—259.
- [6] AD755533.

## FAMILIES OF POINT-TO-SET MAPS AND OPTIMIZATION ALGORITHMS

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 2, Apr 86 pp 165-177

[English abstract of article by Chen Guangjun [7115 1639 6511] of Qufu Teachers' College]

[Text] Some general algorithms were constructed for optimization by families of point-to-set maps, some of which were improvements of the algorithms introduced in [2] and [3]. We showed that under weakened hypotheses the algorithms had better convergence properties. If there was only one member in the family of point-to-set maps, some extensions of Zangwill's theorem were special cases of the algorithms. As an example, the convergences of the variable metric algorithm and Cauchy steepest ascent algorithm with inexact line search were given. (Paper received 28 Nov 83.)

### REFERENCES

- [1] Zangwill, W. I. *Nonlinear Programming, A Unified Approach*, (Prentice Hall, Englewood Cliff, RI), 1969.
- [2] Denel, J., Extensions of the Continuity of Point-to-Set Maps: Applications to Fixed Point Algorithms, *Mathematical Programming Study*, 10(1979), 48-68.
- [3] Yue Minyi, On a  $\rho$ -increasing family of Point-to-Set Maps, *Chin. Ann. of Math.*, 3: 4(1982), 403-414.
- [4] Huard, P., Extensions of Zangwill's Theorem, *Mathematical Programming Study*, 10(1979), 98-103.
- [5] 堵丁柱, 点列集映象和点列集映象族的连续化, *应用数学学报*, 8: 2(1985), 142-150.

THE DURBONX TRANSFORMATION OF AN EIGENVALUE PROBLEM AND THE SOLITON SOLUTIONS OF THE SINE-GORDON EQUATION WITH EXTERNAL FIELD

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 2, Apr 86 pp 196-200

[English abstract of article by Li Yishen [2621 5042 4377] of University of Science and Technology of China]

[Text] The Darboux transformation's method is used to give the solutions of the sine-Gordon equation with external field. (Paper received 16 May 84, finalized 3 Dec 84.)

REFERENCES

- [1] G. L. Lamb, Elements of Soliton Theory, Wiley, New York, 1980.
- [2] L. D. Faddeev, The Inverse Problem in the Quantum Theory of Scattering, *Uspehi Mat. Nauk.* 14(1959), 57.
- [3] M. Wadati, H. Sannki, K. Konno, Relationships Among Inverse Method Bäcklund Transformation and Infinite Number of Conservation Laws, *Prog. Theor. Phys.* 53 (1975), 419.
- [4] P. Deift, E. Trubovitz, Inverse Scattering on the Line *Comm. Pure and Appl. Math.* 32 (1974), 121.
- [5] D. Levi, O. Ragnisco, A. Sym, Dressing Method Vs Classical Darboux Transformation, Preprint, 1983.
- [6] G. Nevsebauer, R. Meinel, "General N- Soliton on the AKNS Class on arbitrary Background, *Phy. Lett. A* 100 (1984), 467.
- [7] 陈登远, AKNB 系统的贝克斯变换可交换性与叠加公式, 讨论班报告, 1984.
- [8] 李明神, Kaup Newell 特征值问题的达布变换, 讨论班报告, 1984.
- [9] M. Boiti, G. Z. Tu, A Simple Approach to the Hamilton Structure of Soliton Equation III, *Nuovo Limento*, 75B (1983), 145.

# CHAOTIC BEHAVIOR OF HAMILTON SYSTEM WITH TWO DEGREES OF FREEDOM

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 2, Apr 86 pp 210-214

[English abstract of article by Liu Zengrong [0491 2582 2837] of Anhui University; and Li Jibin [2621 4949 1755] of Kunming Engineering Institute]

[Text] Hamilton systems having two degrees of freedom with quadratic and cubic nonlinearities, which exist widely in the field of nonlinear oscillation were discussed. By use of the Melnikov method, we find the conditions that result in chaos in the systems. It is illustrated that the chaotic phenomenon is an extremely universal nonlinear phenomenon in the free oscillation system with multi-degrees of freedom. (Paper received 28 May 84, finalized 29 Oct 84.)

## REFERENCES

- [1] 薛柏林, 分叉, 混沌, 奇怪吸引子, 周期和其他, 物理学进展, 2(1983), 329-416.
- [2] 朱国宣, 非线性动力学中的混沌现象, 力学进展, 14(1984), 129-146.
- [3] Edward. Ott, Strange Attractors and Chaotic Motions of Dynamical Systems. *Review of Modern Physics*, 53(1981), 655-671.
- [4] J. Guckenheimer and P. Holmes, Nonlinear Oscillation, Dynamical Systems and Bifurcations of Vector Fields, Springer-Verlag, 1983.
- [5] 李德彬, 刘曾荣, 一类二次系统周期运动的混沌性质, 科学通报, 30: 7(1985), 491-493.
- [6] Holmes, P. J. and Marsden, J. E. Horseshoes in Perturbation of Hamiltonian with two Degree of Freedom, *Comm. Math. Phys.*, 82 (1982), 523-544.

EXACT NULL CONTROLLABILITY FOR A CLASS OF DISCRETE INFINITE DIMENSIONAL LINEAR SYSTEM WITH CONTROL ENERGY CONSTRAINT

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 2, Apr 86 pp 222-226

[English abstract of article by Chen Zhaokuan [7115 0340 1401] of Shandong University]

[Text] A problem of exact null controllability for a class of discrete infinite dimensional linear system with control energy constraint is discussed. A necessary and sufficient condition for this controllability is obtained with using the method of the eigenvector development of the linear operator. (Paper received 5 Jun 84, finalized 19 Aug 85.)

REFERENCES

- [1] 陈云峰、赵怡,线性系统的能控区及其在最优控制中的某些应用,中山大学学报,4(1980),29-33.

ADMISSIBILITY OF LINEAR ESTIMATORS OF REGRESSION COEFFICIENT IN A GENERAL GAUSS-MARKOFF MODEL

Beijing YINGYONG SHUXUE XUEBAO [ACTA MATHEMATICAE APPLICATAE SINICA] in Chinese Vol 9, No 2, Apr 86 pp 251-256

[English abstract of article by Wu Qiguang [0702 0796 0342] of Institute of Systems Science, Academia Sinica]

[Text] Let  $Y$  be a random  $n$ -vector with mean  $X\beta$  and covariance matrix  $\sigma^2V$ , where  $X$  is a known  $n \times p$  matrix and  $V$  is a known symmetric nonnegative definite matrix;  $\beta \in \mathbb{R}^p$  and  $\sigma^2 > 0$  are parameters. Let  $S_\beta$  be linearly estimable. The necessary and sufficient conditions for a linear estimator of  $S_\beta$  to be admissible among linear estimators under the quadratic loss function and matrix loss function are obtained respectively. (Paper received 11 Jul 84.)

REFERENCES

- [1] C. R. Rao, Estimation of parameters in a linear model, *Ann. Statist.*, 4(1976), 1023-1037.
- [2] Wu Qiguang, Admissibility of linear estimates of regression coefficient under matrix loss function, *Kexue Tongbao*, 28(1983), 155-158.
- [3] 朱显海,关于可容许估计的两个定理 (内部资料).

/7358

CSO: 4009/1055

STUDY OF SPECTRA AND CRYSTAL STRUCTURE OF BIPYRIDINE BRIDGING Cu(II) ACETYLACETONATE COMPLEX [ $\mu$ -4,4-bipy-Cu(acac) $_2$ ]

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86 pp 336-342

[English abstract of article by Xu Yuanzhi [1776 0337 2784] and Shi Shu [2457 5289] of Department of Chemistry, Zhejiang University, Hangzhou]

[Text] The crystal and electronic structures of bipyridine bridging Cu(II) acetylacetonate complex [ $\mu$ -4,4-bipy-Cu(acac) $_2$ ] have been studied. The crystals belong to monoclinic system, and space group is  $P2_1/n$ . Its unit cell parameters are:  $a=11.288(5)$ ,  $b=14.507(6)$ ,  $c=11.978(3)\text{\AA}$ ;  $\beta=94.17^\circ$  and  $V=1956(2)\text{\AA}^3$ ,  $Z=4$ ,  $D_m=1.39\text{ g/cm}^3$ ,  $D_c=1.42\text{ g/cm}^3$ . Final unweighted factor  $R=0.054$  for 2260 independent reflections. It is confirmed that the Cu(acac) $_2$  and 4,4-bipy form a one-dimension infinite linear structure with molecular ratio 1:1. By using UV, IR, ESR and NMR spectra, the bonding characteristics of [ $\mu$ -4,4-bipy-Cu(acac) $_2$ ] were compared to Cu(acac) $_2$ . From ESR spectral parameters, the coefficients of molecular orbitals  $\alpha_1$ ,  $\alpha_1'$  and  $\epsilon_\pi$  are calculated approximately. The existence and relative magnitude of contact shifts, pseudo-contact shifts and anisotropic shielding effects are given by analysis of  $^1\text{H}$  NMR spectrum. (Paper received 15 Oct 84, finalized 17 Apr 85.)

## REFERENCES

- [1] Cotton, F. A.; Wilkinson, G., "Advanced Inorganic Chemistry", 3rd Edn., Wiley, New York, 1972, p. 492.
- [2] Graves, J.; Dias, R. M., "The Coordinative Chemistry of Metalloenzymes", Reile, D. Co., 1983, p. 79.
- [3] Karlin, K. D.; Dahlstrom, P. L.; Dipierro, L. J.; Simon, R. A.; Zubieta, J., *J. Coord. Chem.*, 1981, 11, 61.
- [4] Phipps, D. A., "金属与代谢", 科学出版社, 北京, 1983, p. 169.
- [5] Fenton, D. E.; Lintvedt, R. L., *J. Am. Chem. Soc.*, 1978, 100, 6367.
- [6] Tomlinson, A. A. G.; Hathaway, B. J.; Billing, D. E.; Nichol, P., *J. Chem. Soc. (A)*, 1969, 65.
- [7] Procter, I. M.; Stephens, F. S., *J. Chem. Soc. (A)*, 1969, 1248.
- [8] Crapanzosa, S. A.; Myram, E. A., *Ж. експ. химии*, 1969, 10, 290.
- [9] Hathaway, B. J.; Billing, D. E., *Coord. Chem. Rev.*, 1970, 5, 143.
- [10] Kivelson, D.; Lee, S. K., *J. Chem. Phys.*, 1964, 41, 1896.
- [11] Eaton, D. R., *J. Am. Chem. Soc.*, 1965, 87, 3097.
- [12] 徐元植, 施舒, 待发表.
- [13] Happe, J. A.; Ward, B. L., *J. Chem. Phys.*, 1963, 39, 1211.
- [14] McConnell, H. M.; Chesnut, D. B., *J. Chem. Phys.*, 1958, 28, 107.
- [15] 唐放庆, 江元生, 郑国森, 戴树珊, "分子轨道图形理论", 科学出版社, 北京 1980, p. 20.

## INVESTIGATION OF SINGLE $\text{MoFe}_3\text{S}_4$ CUBANE CLUSTER

### I. SYNTHESIS BY SPONTANEOUS SELF-ASSEMBLY REACTION AND STRUCTURE OF $(\text{Et}_4\text{N}) [\text{MoFe}_3\text{S}_4(\text{Et}_2\text{NCSS})_5]\text{CH}_3\text{CN}$

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86 pp 343-349

[English abstract of article by Liu Qiutian [0491 4428 3944], et al., of Fujian Institute of Research on the Structure of Matter, Academia Sinica, Fuzhou]

[Text] A single  $\text{MoFe}_3\text{S}_4$  cubane-like cluster compound has been synthesized through spontaneous self-assembly of simple inorganic salts with organosulfur ligand for the first time.  $(\text{Et}_4\text{N}) [\text{MoFe}_3\text{S}_4(\text{Et}_2\text{NCSS})_5]\text{CH}_3\text{CN}$  (1) is quite stable in air. The crystal of 1 is monoclinic with space group  $\text{P}2_1/\text{c}$ ,  $a=22.897(3)\text{\AA}$ ,  $c=20.928(4)\text{\AA}$ ,  $\beta=97.15(1)^\circ$  and  $Z=4$ . A full matrix least-squares refinement with 6725 unique reflections for all nonhydrogen atoms gives  $R=0.068$ .

The anion of 1 is the first isolated single  $\text{MoFe}_3\text{S}_4$  cubane cluster with core oxidation state  $[\text{MoFe}_3\text{S}_4]^{4+}$ . The distance between the two six-coordinate metal atoms (Mo, Fe) is  $2.624\text{\AA}$ , which is the shortest M-M bond observed for Mo-Fe-S clusters so far and the only one shorter than similar distances in FeMo-cofactor.

The bond orders for this anion were calculated by EHMO method and the results coincide with the general rule. The structural feature and the unusual stability of 1 can be attributed to the bidentate chelating effect of  $\text{Et}_2\text{NCSS}$ , which leads to high coordination of metal atoms and the various ligated types. (Paper received 8 Jan 85.)

### REFERENCES

- [1] (a) 中国科学院福建物质结构研究所固氮研究小组, 科学通报, 1975, 20, 540; (b) Lu J.-X., "Nitrogen Fixation", Vol. I, ed. by Newton, W. E.; Orme-Johnson, H. E., University Park Press, Baltimore, 1980, p. 343.
- [2] Cramer, S. P.; Hodgson, K. O.; Gillum, W. O.; Mortenson, L. E., *J. Am. Chem. Soc.*, 1973, 100, 3398.
- [3] Holm, R. H., *Chem. Soc. Rev.*, 1981, 10, 455.
- [4] Christou, G.; Garner, C. D.; Mabbs, F. E.; King, T. J., *J. Chem. Soc. Chem. Commun.*, 1978, 740.
- [5] (a) Mascharak, P. K.; Armstrong, W. H.; Mizobe, Y.; Holm, R. H., *J. Am. Chem. Soc.*, 1983, 105, 475; (b) Palermo, R. E.; Holm, R. H., *J. Am. Chem. Soc.*, 1983, 105, 4310; (c) Palermo, R. E.; Singh, R.; Bashkin, J. K.; Holm, R. H., *J. Am. Chem. Soc.*, 1984, 106, 2600.
- [6] 刘秋田, 黄梁仁, 王玲玲, 康北笙, 卢嘉锡, 结构化学, 1983, 2, 291.
- [7] Burgess, B. K.; Yang, S. S.; You, C. B.; Li, J. G.; Friesen, G. D.; Pan, W. H.; Stiefel, E. I.; Newton, W. E.; Conradson, S. D.; Hodgson, K. O., "Current Perspectives in Nitrogen Fixation", ed. by Gibson, A. H.; Newton, W. E., Australian Academy of Science, Canberra, 1981, p. 71.
- [8] Kanatzidis, M. G.; Ryan, M.; Coucouvanis, D., *Inorg. Chem.*, 1983, 22, 179.

THE KINETIC STUDY FOR SELECTIVE OXIDATION OF PROPYLENE ON THE CATALYSTS OF BISMUTH AND CERIUM MOLYBDATE MIXTURES

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86 pp 350-356

[English abstract of article by Yang Huixing [2799 1920 2502], et al., of Department of Chemistry, Peking University, Beijing]

[Text] The influence of Ce on the selective oxidation of propylene catalyzed by bismuth molybdate was studied. Kinetic results show that different Bi-Ce ratios of the catalyst exhibit comparatively complex behaviors. Following the change of the composition of the catalyst, the order of the oxidation changes from zero through 0.5 to no definite order and simultaneously the order for propylene also undergoes a great change as the composition of catalyst changes. To explain this phenomenon, an unified reaction mechanism is suggested so that as the composition of the catalyst changes the surface active center changes from the lattice oxygen, through the atomic state, to molecular state. Through X-ray, infrared and other studies, it is shown that, such a change of surface active centers is due to the formation of cerium molybdate phase which spoiled the formation of lattice of bismuth molybdate, thus making the latter more dispersed. (Paper received 11 Jan 85.)

REFERENCES

- [1] Keulks, G. W.; Krenzke, L. D.; Notermann, T. N., *Adv. Catal.*, **1978**, *27*, 183.
- [2] Krenzke, L. D.; Keulks, G. W., *J. Catal.*, **1980**, *61*, 316.
- [3] Monnier, J. R.; Keulks, G. W., *J. Catal.*, **1981**, *68*, 51.
- [4] Monnier, J. R.; Keulks, G. W., *J. Catal.*, **1981**, *68*, 63.
- [5] 张要奇, 未发表.

# SYNTHESIS OF 1,1,1-TRICHLORO-2-SUBSTITUTED HYDRAZINO-3-NITROPROPANE AND ITS DERIVATIVES

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86 pp 360-373

[English abstract of article by Chen Qijie [7115 0366 2638] of Institute of Element-Organic Chemistry, Nankai University, Tianjin]

[Text] The syntheses of fourty-three novel aliphatic and aromatic hydrazine, hydrazide, azo and hydrazone compounds from 1,1,1-trichloro-2-acetoxy-3-nitropropane and 1,1, 1-trichloro-2-hydrazino-3-nitropropane were described.

Alkyl  $\beta$ -nitropyruvate arylhydrazone can be obtained conveniently by oxidation of N-aryl -N'-[2-(1,1,1-trichloro-3-nitro)propyl] hydrazine with N-bromosuccinimide followed by the treatment with excess alcohol and equivalent amount of water without isolating the intermediary 1,1-dichloro-2-arylaazo-3-nitropropene. This is a simple and convenient method for the preparation of  $\beta$ -substituted pyruvate derivatives in relatively high yields.

Preliminary bioassays indicated that most of these compounds exhibited various degree of fungistatic activity. The hydrazine and azo derivatives are more effective than the pyruvate hydrazones. (Paper received 25 Jun 84, finalized 28 Dec 84.)

## REFERENCES

- [1] 陈其杰, 刘凤萍, 谢龙观, 张玉芬, 张祖新, 芦建华, 农药, 1982, (3), 3.
- [2] Royals, E. E., "Advance Organic Chemistry", Prentice-Hall Inc., New York, 1954, p. 653.
- [3] Chattaway, F. D.; Witherington, P., J. Chem. Soc., 1939, 1179.
- [4] Brower, F. D.; Burkett, H., J. Am. Chem. Soc., 1953, 75, 1082.
- [5] Tomita, M.; Ikawa, K., J. Pharm. Soc. Jpn., 1955, 75, 449.
- [6] Friedman, L.; Little, B.; Reichle, W. B., "Organic Syntheses", Coll. Vol. V, ed. by Baumgarten, H. E., 1973, p. 1055.
- [7] Kulka, M., Can. J. Chem., 1969, 37, 525.
- [8] Bechman, G. B.; Standish, N. W., J. Org. Chem., 1961, 26, 1474.
- [9] Hadzi, D.; Jan, J., Rev. Roumaine Chim., 1965, 10, 1183 [Chem. Abstr., 1966, 65, 600e].
- [10] Bellamy, L. J., "The Infra-red Spectra of Complex Molecules", Chapman & Hall, London, 1975, pp. 204, 207, 209.
- [11] Chamberlain, N. F., "The Practice of NMR Spectroscopy with Spectra-Structure Correlations for Hydrogen-1", Plenum Press, New York 1974, pp. 183, 189.
- [12] Kitaev, Yu. P.; Nivorozhkin, L. E.; Titova, Z. S.; Popova, G. V., Izv. Akad. Nauk SSSR, Ser. Khim., 1968, 729 [Chem. Abstr., 1968, 69, 76456y].
- [13] Breitmaier, E.; Voelter, W., "13C NMR Spectroscopy", 2nd Edn., Verlag Chemie, Weinheim, New York, 1978, pp. 78, 174, 181.
- [14] Chattaway, F. D.; Daldy, F. G., J. Chem. Soc., 1938, 2756.
- [15] Crane, C. W.; Forrest, J.; Stephenson, O.; Waters, W. A., J. Chem. Soc., 1946, 829.

# CRYSTAL STRUCTURE OF EUROPIUM TRICHLORIDE TETRAPYRIDINE

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86  
pp 388-391

[English abstract of article by Hu Ninghai [5170 1337 3189], et al., of Changchun Institute of Applied Chemistry, Academia Sinica, Changchun]

[Text] The crystal of europium trichloride tetrapyridine ( $\text{EuCl}_3 \cdot 4\text{PY}$ ) belong to the monoclinic system. The space group is  $P2_1/n$ , with  $a=15.925(4)$ ,  $b=17.225(5)$ ,  $c=9.780(7)\text{\AA}$ ,  $\beta=103.28(2)^\circ$ ,  $Z=4$ . The intensity data of 5045 independent reflections were collected using a PW-1100 four-circle diffractometer. The structure was solved by the heavy-atom method. The structure parameters were refined by block-diagonal least-squares method, final discrepancy  $R=0.073$ . A slightly distorted pentagonal bipyramid polyhedron is formed by three chlorine and four nitrogen atoms surrounding the europium atom. The average bond lengths:  $\text{Eu-Cl}=2.654\text{\AA}$  and  $\text{Eu-N}=2.600\text{\AA}$ . (Paper received 17 Dec 84.)

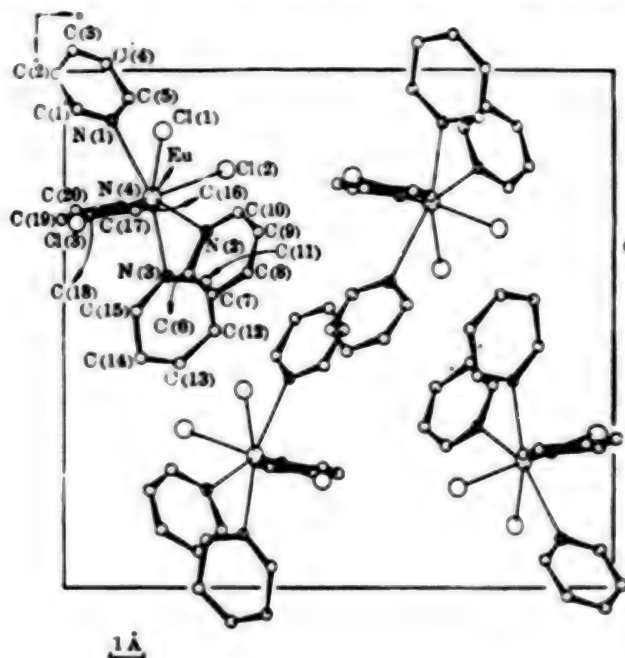


Fig. 1. Shadowing of crystal structure at (001) plane

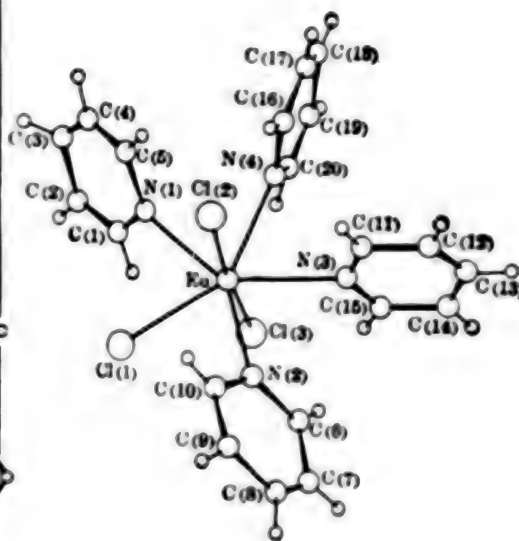


Fig. 2. Structural type of  $\text{EuCl}_3 \cdot 4\text{Py}$  molecule

## REFERENCES

- [1] Matignon, C., *Ann. Chem. Phys.*, **1908**, *8*, 243.
- [2] 沈琪, 张志敏, 田鹤琴, 张淑芬, 刘国智, *应用化学*, **1984**, *2*, 95.
- [3] 中国科学院长春应用化学研究所, "稀土化学论文集", 科学出版社, 北京, **1982**, 122.
- [4] Al-Karaghoul, A. B.; Wood, J. B., *J. Am. Chem. Soc.*, **1968**, *90*, 6548.
- [5] Horrocks, W. D., Jr.; Sipe, J. P., III; Luber, J. R., *J. Am. Chem. Soc.*, **1971**, *93*, 5258.
- [6] Morosin, B., *J. Chem. Phys.*, **1968**, *49*, 3007.
- [7] 汤卡罗, 甘志, 潘佐华, 金祥林, *北京大学学报(自然科学版)*, **1984**, *3*, 43.

## THE ANODIC FILM OF LEAD-ANTIMONY ALLOYS IN SULFURIC ACID SOLUTION

### III. THE EFFECT OF CYCLIC TRIANGULAR WAVE POTENTIAL SWEEP ON THE GROWTH OF THE ANODIC FILM

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86 pp 399-401

[English abstract of article by Zhou Weifang [0719 0251 5302], et al., of Department of Chemistry, Fudan University, Shanghai]

[Text] The anodic film on lead and three kinds of its Sb-based alloys in  $4.5 \text{ mol.dm}^{-3} \text{ H}_2\text{SO}_4$  ( $30^\circ\text{C}$ ) are studied by cyclic voltammetry with sweep rate of  $9.2 \text{ mV.s}^{-1}$ , and sweep potential range between 0.90 and 1.45V vs.  $\text{Hg/Hg}_2\text{SO}_4$  electrode. Cyclic voltammetry shows the major constituent of the said anodic film formed during a 50 cycle test is porous  $\text{PbO}_2$  film. The order of decreasing growth rate of  $\text{PbO}_2$  film is:



(Paper received 21 Jan 85.)

#### REFERENCES

- [1] Zhou Weifang, Chen Xialin [7115 7209 3781] HUAXUE XUEBAO [ACTA CHIMICA SINICA] Vol 43, 1985 p 333.
- [2] Zhou Weifang, Chen Xialin, HUAXUE XUEBAO [ACTA CHIMICA SINICA] Vol 43, 1985 p 810.

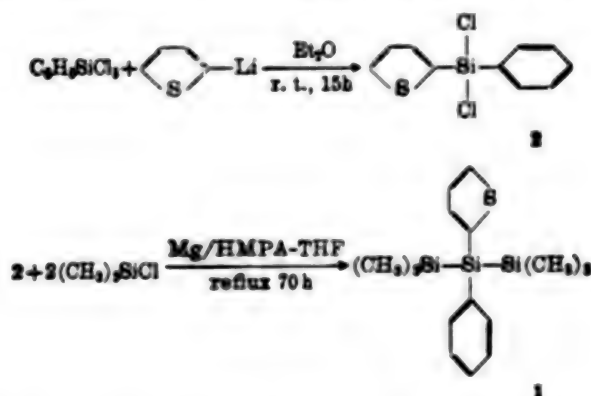
III. THE GENERATION AND TRAPPING OF  $\alpha$ -THIENYLPHENYLSILYLENE

Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 44, No 4, Apr 86 pp 427-430

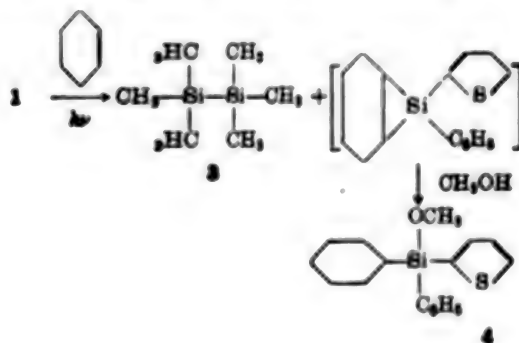
[English abstract of article by Wu Shihui [0702 0013 2547], et al., of Department of Chemistry, Fudan University, Shanghai]

[Text] Both carbenes (Divalent carbon) and its counterparts silylenes (divalent silicon) are elementary intermediates. But up to now, there is only one paper talked about hetrocycle containing silylene. In that paper we have reported the generation and trapping of furylphenylsilylene. The thiophene ring contains a sulfur atom, which locates at the same group with the oxygen of furan. But the sulfur belongs to third-row element, its out-shell electrons are 3s and 3p. Those electrons are farther away from the nucleus. So it might have some properties differing from that in furylphenylsilylene.

The precursor for the generation of  $\alpha$ -thienylphenylsilylene is 2-( $\alpha$ -thienyl)-2-phenylhexamethyltrisilane (1). When  $\alpha$ -thienyllithium reacted with phenyltrichlorosilane,  $\alpha$ -thienylphenyldichlorosilane (2) was obtained (yield 32.9%). 2 and trimethylchlorosilane in the presence of hexamethylphosphoramide (HMPA) in tetrahydrofuran reacted with magnesium, and then compound 1 to be produced (yield 32%).



Irradiation of 1 in cyclohexene and methanol by a 450W Honovia lamp for 12 h, two expected products were obtained: hexamethyldisilane (yield 23.9%) and  $\alpha$ -thienylphenylcyclohexylmethoxysilane (4) (yield 9.3%).



The structure of **4** was confirmed by conventional synthesis of authentic compound and compared their spectroscopy data. When **2** reacted with cyclohexylmagnesium bromide and treated with methanol, the authentic sample of **4** was obtained.

It is clear that we have trapped the first thiophene containing silylene.

The analytical data of compound **1** and **4** are following:

**1**  $C_{16}H_{20}Si_2S$  (calculated: C, 57.42; H, 7.83. Found: C, 57.62; H, 7.88).  $\lambda_{max}$  (EtOH): 280nm.  $\nu_{max}$ : 3050(m, —OH), 2950(s,  $CH_3$ ), 2900(m,  $CH_2$ ), 1585(vw) and 1480(w) (benzene ring and thiophene ring), 1425(m,  $SiC_6H_5$ ), 1400(m,  $SiCH_3$ ), 1245(s,  $SiCH_3$ ), 1210(m, substituted thiophene ring), 1092(s,  $SiC_6H_5$ )  $cm^{-1}$ .  $\delta_H$  ( $CCl_4$ ,  $CH_2Cl_2$  as inner standard): 0.29[18H, s,  $6 \times (SiCH_3)$ ], 7.17~7.66(8H, m, Ar—H and thienyl protons) ppm.  $m/z$ : 334( $M^+$ , 16.62%), 73[( $OH_2$ ) $_2Si^+$ , 100].

**4**  $C_{17}H_{22}OSiS$  (calculated: C, 67.50; H, 7.83. Found: C, 67.48; H, 7.80).  $\nu_{max}$ : 3080(w, —OH), 2985(s,  $OH_2$ ), 2920(m,  $CH_2$ ), 1588(vw) and 1492(w, benzene ring and thiophene ring), 1425(m,  $SiC_6H_5$ ), 1400(m,  $SiCH_3$ ), 1210(m, substituted thiophene ring), 1110(s,  $SiOCH_3$ ), 1085(s,  $SiC_6H_5$ )  $cm^{-1}$ .  $\delta_H$  ( $CCl_4$ ,  $CH_2Cl_2$  as inner standard): 1.19~2.18 (11H, m, cyclohexyl protons), 3.60(3H, s,  $OCH_3$ ), 7.15~7.69 (8H, m, Ar—H and thienyl protons) ppm.  $m/z$ : 302( $M^+$ , 5.72%), 219( $M^+ - C_6H_{11}$ , 100).

(Paper received 25 Sep 85.)

#### REFERENCES

- [1] (a) Gaspar, P. P., "Reactive Intermediates", ed. by Moss, R. A.; Jones, M., Jr., Wiley, New York, 1978; Vol. 1, Chap. 3, p. 69; (b) Idem, Ibid., 1981; Vol. 2, Chap. 3, p. 59; (c) 陶凤岗, 许临晓, 吴世辉, 有机化学, 1983 (3), 161; (d) Gaspar, P. P., "Reactive Intermediates", ed. by Moss, R. A.; Jones, M., Jr., Wiley, New York, 1983; Vol. 3, p. 336.
- [2] 吴世辉, 武戈, 陶凤岗, 林子森, 科学通报, 1983, 28, 243.
- [3] Tortorelli, V. J.; Jones, M., Jr.; Wu, S.-H.; Li, Z. -H., *Organometallics*, 1983, 2, 759.

/7358

CSO: 4009/1053

FIRST-ORDER DERIVATIVE SPECTROPHOTOMETRIC DETERMINATION OF MICRO-AMOUNT OF ZIRCONIUM IN SILVER-PALLADIUM ALLOYS WITH P-HIPPURIC ACID CHLOROPHOSPHONAZO

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8, No 2, 28 Apr 86  
pp 76-79

[English abstract of article by Wang Qingyue [3769 7230 6460] of Shanghai Non-Ferrous Metals Research Institute]

[Text] A rapid, selective and sensitive first-order derivative spectrophotometric method for the determination of zirconium based on the color reaction with p-hippuric acid chlorophosphonazo in the presence of OP has been developed. The suitable acidity for the formation of the stable complex is 0.004~2.0 N of hydrochloric acid. The zirconium to ligand ratio is 1:2. More than 50 kinds of substances do not interfere the determination of zirconium. The procedure can be applied to the direct determination of 0.05~0.8 percent zirconium in Ag-Pd alloys. (Paper received 17 Dec 84.)

SYNTHESES AND PROPERTIES OF MACROPOROUS CHELATE RESINS OF CROSSLINKED DITHIO-CARBOXYLATED POLYVINYLBENZYLAMINE AND ITS OXIDIZED PRODUCT

Beijing HUAXUE SHIJI [CHEMICAL REAGENTS] in Chinese Vol 8, No 2, 28 Apr 86  
pp 80-84

[English abstract of article by Chen Yigong [7115 5030 6978], et al., of Department of Chemistry, Hangzhou University; Cheng Xinliang [4453 0207 5328], et al., of Department of Rock Chemistry, Chang Chun Geology College]

[Text] The title resins bearing-NHCSSNa (1) and -NHCSS-SSCNHO (2) group with high content of the functional group were prepared. The high conversion of the functional groups was confirmed by IR-spectra and elementary analysis.

The adsorption capacities of resin (1) and resin (2) for  $\text{Cu}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ag}^+$ ,  $\text{Hg}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Au}^{3+}$  are 4.07~0.51 and 3.81~0.59 meq ion/g, respectively. The influences of pH, adsorption time on the percentage of ion adsorption and adsorption selectivities were determined. The adsorbed  $\text{Cu}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$  ions can be quantitatively eluted by 5N  $\text{HNO}_3$ . Large amount of  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$  did not interfere with the elution.  
(Paper received 15 Aug 84.)

REFERENCES

- [1] G. A. Thorn, and R. A. Ludwig, «The Dithiocarbamates and Related Compounds», Elsevier, New York, (1972)
- [2] J. F. Dingman, Jr., K. M. Gloss, E. A. Milano, and S. Siggia, *Anal. Chem.*, 46(6), 774 (1974)
- [3] 陈义德、顾振梅, 化学试剂, 2(4), 214 (1980)
- [4] 陈义德、顾振梅, 高分子通讯, (6), 443(1982);  
Chen Yiyong, and Gu Zhenmei, *Polymer Commun.*, 1(2), 152 (1983)
- [5] T. Saegusa, S. Kobayashi, K. Hayashi, and A. Yamada, *Polym. J.*, 10(4), 403 (1978)
- [6] 钱庭宝、李春荣、王补森、朱瑞慧、宋福云、何炳林, 化学试剂, 3(4), 193 (1981)
- [7] R. M. Barnes, and J. S. Genna, *Anal. Chem.*, 51(7), 1065 (1979)
- [8] M. B. Colella, S. Siggia, and R. M. Barnes, *Anal. Chem.*, 52(6), 967 (1980)
- [9] A. Miyazaki, and R. M. Barnes, *Anal. Chem.*, 53(2), 299 (1981)

/7358

CSO: 4009/1069

## PHOTOINITIATION ACTIVITIES OF SOME BENZOIN ALKYL ETHERS

Guangzhou ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI] in Chinese No 2, May 85 pp 60-64

[English abstract of article by He Yi [0149 1355], Wang Lichang [3769 0500 2490], Liang Zhaoxi [4731 0340 3556], and Li Manfu [2621 2581 1318] of the High Polymer Research Institute]

[Text] Using benzoïn alkyl ethers as photoinitiators, the polymerization of n-butyl methacrylate was carried out in bulk. The polymerization rates were measured by a dilatometer. The determined photoinitiation activities of the photoinitiators were in order as follows: Benzoïn Methyl ether>benzoïn ethyl ether>benzoïn isopropyl ether>alpha-hydroxymethyl benzoïn methyl ether>benzoïn>benzil>ethylene ketal. The abilities are related to their alpha-substituted groups participating in conjugation. (Paper received June 1984.)

### References:

- [1] R.C. Stephen et al, *J. Macromol. Sci.—Chem.*, A14(1980), 1, 69.
- [2] H.G. Heine und H.J. Traenckner, *Progress in Org. Coatings*, 3(1975), 115.
- [3] S.E. Young, *Progress in Org. Coatings*, 4(1976), 225.
- [4] S. Peter Pappas, *Progress in Org. Coatings*, 2(1973/74), 342.
- [5] Hendrik J. Hageman et al., *macromol. Chem.*, 180(1979), 2531.
- [6] 陈用烈、梁兆熙等, 中山大学学报(自然科学版), 1983, 3, 114.
- [7] 王尔富、李妙贞等, 高分子通讯, 1981, 5, 381.
- [8] 寿明谦, 有机化合物的同系线性规律, 科学出版社, 1980年, 350—352.

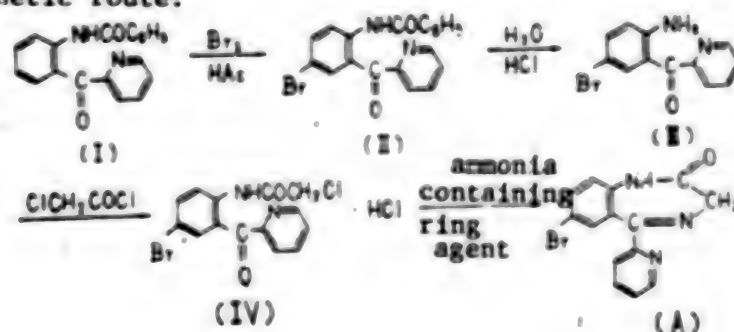
# NEW SYNTHESIS OF BROMAZEPAM

Guangzhou ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI] in Chinese No 2, May 85 pp 115-118

[English abstract of article by Ying Baining [5391 2672 1380], Zhong Zengpei [6988 1073 1014], and Chen Bailing [7115 2672 2651] of the Chemistry Department]

[Text] Improvements in procedures were made for the synthesis of bromazepam (7-bromo-5-(2-pyridyl)-3H-1, 4-benzodiazepine-2 (1H)-one) in high yield, 2-(2-amino-5-bromo-benzoyl) pyridine was prepared by bromination, followed by hydrolysis. The hydrochloride of 2-(2-chloroacetamino-5-bromo-benzoyl) pyridine could be separated as an intermediate before the ring closure to form bromazepam. (Paper received May 1984.)

Synthetic route:



## References:

- (1) Leickert, K. H., *Med. Welt.*, 28 (1977), 1317-1321.
- (2) Michael, J., Ierodiakonou, C., Mavropoulos, T., Diakoyiannis, A., *Helleniatr.*, 48 (1977), 172-179.
- (3) U. S. part. 3,100,770 (1963); U. S. part. 3,182,065 (1965); U. S. part. 3,182,085 (1965).
- (4) R. Ian Fryer, R. A. Schmidt and L. H. Sternbach, *J. Pharm. Sciences*, 57(1968), 3, 264, 3.
- (5) U. S. part. 3,182,067.
- (6) U. S. part. 3,886,141.
- (7) M. Yamamoto, S. Inaba and H. Yamamoto, *Chem. Pharm. Bull.*, 26(1978), 6, 1673-1681.
- (8) 罗柏宁、钟增培等, *医药工业* 1984, 2, 39.

## Dynamics

### NEW METHOD FOR INTERFACE DYNAMIC INVESTIGATION IN SOLID STATE PHASE TRANSFORMATIONS

Guangzhou ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI] in Chinese No 2, May 85 pp 45-49

[English abstract of article by Zhang Jinxiu [1728 6651 0208] and Li Xiejun [2621 3610 0971] of the Physics Department]

[Text] There are two forces, phase transition driving force  $\Delta G$  and resistant force, exerting on the moving interface in the process of solid state phase transformation (SSPT). The interface moves when the driving force  $\Delta G$  reaches a critical value  $\Delta G_R$  to overcome the resistant force. It is reasonable to postulate the average velocity of moving  $\Delta G' = \Delta G - \Delta G_R$ , i.e.  $V = \varphi(\Delta G - \Delta G_R) = \varphi(\Delta G')$ . Starting from the elementary consideration of solid state transition theory and internal friction theory, the relation between interface dynamic function  $V = \varphi(\Delta G')$  and some physical parameters was obtained as

$$c \frac{d \ln \varphi(\Delta G')}{d \Delta G'} = Q^{-1} \omega / \mu \frac{dF}{d\xi} \frac{d\xi}{dt}$$

where  $c$  is a coupling coefficient,  $Q^{-1}$  is the internal friction in the process of SSPT,  $\omega$  is the frequency of vibration of the specimen in the internal friction measurement process,  $\mu$  is modulus,  $\frac{dF}{d\xi}$  is transformation rate and  $\frac{d\xi}{dt}$  is the varying rate of the acting field. All the parameters in the right side are measurable. So, it is possible to drive the dynamic function  $V = \varphi(\Delta G - \Delta G_R)$  from experimental data.

The possible applications of this method to the investigation of SSPT were discussed and some application examples were listed. (Paper received August 1984).

- References: (1) 冯端, 物理, 1984, 3, 1.  
 (2) T. H. O'Dell, Ferromagnetodynamics, The dynamics of magnetic bubbles, domains and domain walls, Macmillan (1981), Chapt., 1-2.  
 (3) 徐祖耀, 马氏体相变和马氏体, 第四章, 科学出版社, 1980.  
 (4) 张进修, 中山大学学报(自然科学版), 1982, 3, 1; *J de Physique*, 42 (1981), C5-389.  
 (5) 王业宁等, 南京大学学报(自然科学版), 7 (1963), 3; 高等学校自然科学学报(物理学报), 1965, 试刊第五期, 352.  
 (6) O. Mercier et al., *Acta Met.*, 27 (1979), 1407.  
 (7) 夏伍戎、水嘉麟、王子孝、周如松, 武汉大学学报(自然科学版), 1983, 3, 41.  
 (8) F. Wollants et al., *Zeit. Metallkde.*, 70 (1979), 113.

# A HIGH SPEED NMOS PARALLEL MULTIPLIER

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86 pp 1-6

[English abstract of article by Mao Yuhai [5403 0060 3189] of Qinghua University, Beijing]

[Text] A new configuration of high speed parallel multiplier is presented. In this configuration, Wallace tree is used to simplify the modified Booth's algorithm. Carry save adders, suitable for NMOS implementation, are used. In the last level of two bits addition, Manchester type adder with fast carry propagation is used instead of ordinary carry look-ahead adder. A new NMOS realization of Manchester adder is presented. The total gate count of this high speed parallel multiplier is less than that of the ordinary multiplier with modified Booth's algorithm. The time of multiplication is also reduced. Furthermore, the configuration of CSA array is much more regular. It is especially suitable for VLSI layout design. (Paper received Feb 85, finalized Apr 85.)

## REFERENCES

- [1] D. J. Geist: MOS Processor picks up speed with bipolar multipliers, Electronics, P.113, July 1977.
- [2] O. L. MacSorley: High-speed arithmetic in binary computers, Proc. IRE, Vol. 49, pp.67-91, Jan.1961.
- [3] C.S. Wallace: A suggestion for a fast multiplier, IEEE Trans., Vol. EC-13, pp.14-17, Feb.1964.
- [4] A. D. Booth: A signed binary multiplication technique. Quart. J. Mech. Appl. Math. Vol.4, Part 2, 1951.
- [5] L. P. Rubinfield: A Proof of the modified Booth's algorithm for multiplication, IEEE Trans., Vol.C-24 pp. 1014-1015, Oct.1975.
- [6] S. Waser: High-speed monolithic multipliers for real-time digital signal processing. Computer, pp.19-29, Oct. 1978.
- [7] R. T. Masumoto: The design of a 16x16 Multiplier, LAMBDA pp.15-21, First Quarter, 1980.
- [8] C. Mead, L. Conway: Introduction to VLSI Systems. Addison-Wesley Publishing Co., 1980.
- [9] T. Kilburn, D. B. G. Edward, D. Aspinall: A parallel arithmetic unit using a saturated transistor fast-carry circuit, Proc. IEE. pt.8, Vol.107, pp.573-584, Nov. 1960.
- [10] C. P. Lerouge, P. Girard, J. S. Colardelle: A fast 16 bit NMOS parallel multiplier, IEEE J. of Solid-State Circuits, Vol. SC-19, No.3, pp. 338-342, June 1984.

## A THEOREM OF THE INVARIANCE OF THE SCATTERING MATRIX OF N-PORT NETWORKS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86 pp 7-14

[English abstract of article by Huang Xiangfu [7806 7449 7450] and He Shide [6320 1597 1795] of Chengdu Institute of Radio Engineering]

[Text] A new theorem of the invariance of the scattering matrix of n-port networks is proposed and proved. The theorem is useful in the analysis and design of electrical networks, and some of its applications are mentioned briefly. (Paper received Jan 85, finalized Aug 85.)

### REFERENCES

- [1] Wai-kai Chen: Theory and Design of Broadband Matching Networks, Pergamon Press, New York, 1976.
- [2] H. J. Carlin, B. S. Yarman: IEEE Trans. on CAS, No. 1, pp. 15-28, 1983.
- [3] B. S. Yarman, H. J. Carlin: IEEE Trans. on MTT, No. 12, pp. 2216-2222, 1982.
- [4] 黄香馥: 宽带匹配网络, 电子工业出版社, (待出版)。
- [5] H. J. Carlin: IEEE Trans. on CAS, No. 4, pp. 170-175, 1977.
- [6] H. J. Carlin, J. Komiak: IEEE Trans. on MTT, No. 2, pp. 93-99, 1979.

# GENERALIZED EVEN-ODD MODE EXPANSION AND THINNING TECHNIQUE FOR COMPUTATION OF WIRE ANTENNAS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86 pp 14-18

[English abstract of article by Liang Changhong [2733 2490 3163] and Meng Zhiqi [1322 1807 1142] of Northwest Telecommunication Engineering Institute, Xian]

[Text] A new method for computation of wire antennas is discussed. In case of symmetrical geometry of wire antennas or arrays with any voltage excitation, generalized even-odd mode expansion method can be used. This method and judicious applications of thinning technique will save about half computation time without sacrificing the specified accuracy. Some examples are given. (Paper received Jan 85, finalized Apr 85.)

## REFERENCES

- [1] D. K. Cheng, C. H. Liang: Thinning technique for moment method solutions, Proc. IEEE, Vol. 71, No. 2, pp. 265-266, Feb. 1983.
- [2] R. F. Harrington: Field Computation by Moment Methods, New York, Macmillan, 1968.
- [3] S. Barnett: Matrix Method for Engineers and Scientists, McGraw-Hill Book Company(UK), 1979.
- [4] D. K. Cheng, C. H. Liang: Shaped wire antennas with maximum directivity, Electronics Letters, Vol 18, No. 19, pp. 816-818, Sept. 1982.

## THE AR SPECTRAL ESTIMATE ALGORITHM OF CANCELLING NOISE EFFECTS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86 pp 33-40

[English abstract of article by Yu Huili [0151 6540 6849] of No. 634 Research Institute, Ministry of Aviation Industry, Beijing]

[Text] AR series obtained by observation, as they are mixed with observed noise, often reduce greatly both the resolution and the estimating performance of AR spectral estimation. The recursive algorithm of Householder transform is applied for AR spectral estimation by forming the high-order autocorrelation matrix, and an unbiased estimation of AR parameters is obtained. Thus, the noise pollution to AR spectral is overcome and a better estimation performance is ensured. (Paper received Dec 84, finalized Jun 85.)

### REFERENCES

- [1] S. M. Kay: The effects of noise on the autoregressive spectral estimator, IEEE Trans., Vol. ASSP-27, pp. 478-485, Oct. 1979.
- [2] S. M. Kay, S. L. Marple: Spectrum analysis—A modern perspective, Proc. of IEEE, Vol. 69, No. 11, Nov. 1981.
- [3] P. D. Scott, C. L. Nikias: Energy-weighted linear predictive spectral estimation, IEEE Trans., Vol. ASSP-30, pp. 287-292, Apr. 1982.
- [4] S. M. Kay: Noise compensation for autoregressive spectral estimation, IEEE Trans., Vol. ASSP-28, pp. 292-303, June 1980.
- [5] J. A. Cadzow: High performance spectral estimation—a new ARMA method, IEEE Trans., Vol. ASSP-28, pp. 524-529, Oct. 1980.
- [6] J. M. Melsa, J. S. Tomcik: Linear predictive coding with additive noise for application to speech digitization, in Proc. 14th Allerton Conf. Circuits and Systems Theory, pp. 500-508, Sept. 1976.
- [7] Y. T. Chan and R. P. Langford: Spectral estimation via the high-order Yule-Walker equations, IEEE Trans., Vol. ASSP-30, pp. 689-698, Oct. 1982.
- [8] 冯康等:《数值计算方法》,国防工业出版社,1978.
- [9] 黄俊钦,张健志:一种同时估计模型阶次与参数的算法,仪器仪表学报, No. 4, pp. 338-342, 1984.
- [10] 黄俊钦、余晖里:一种新的AR谱估计算法,全国数字信号处理学术会议论文集,1984.
- [11] S. L. Marple: A new autoregressive spectral analysis algorithm, IEEE Trans., Vol. ASSP-28, pp. 441-454, Aug. 1980.

## THE LOCAL ACCURACY OF MEAN SQUARED DIFFERENCE TEMPLATE MATCHING SYSTEMS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86  
pp 48-53

[English abstract of article by Peng Jiaxiong [1756 0857 7160] of Institute of Pattern Recognition and Artificial Intelligence, Huazhong University of Science and Technology]

[Text] Under the conditions that the signal and noise are two independent, mean square differentiable two-dimensional homogeneous Gaussian random fields and the mathematical expectation of noise is zero, the three important properties of mean squared difference template matching systems are proved, and the local accuracy estimation formulas of the contain-wise and pass-wise two matching manners are derived. When the integral distance, autocorrelation functions of signal and noise are known, the local accuracy for a system can be analytically computed and evaluated. (Paper received Dec 84, finalized Sep 85.)

### REFERENCES

- [1] G. J. Vanderbrug, A. Rosenfeld: Two-stage template matching, IEEE Trans., Vol. C-26, No. 4, pp.384-393, 1977.
- [2] B. V. K. Vijaya Kumar, D. Casasent: Binarization effects in a correlator with noisy input data, Applied Optics, Vol. 20, No.8, pp.1433-1437, 1981.
- [3] H. K. Ramapriyan: A multilevel approach to sequential detection of pictorial features, IEEE Trans., Vol. C-25, No.1, pp.66-78, 1976.
- [4] L. D. Hostetler: An analysis of terrain-aided inertial navigation system, SAND75-0290, Sept. 1975.
- [5] P. R. Hinrichs: Advanced terrain correlation techniques, IEEE 1976 Position Location and Navigation Symp., pp.89-96, 1976.
- [6] D. A. Fogle, R. H. Goebel: The two-dimensional accuracy of a one-dimensional correlator, Proc. of 1976 IEEE Southeastcon Region 3 Conf., pp.230-232, 1976.
- [7] 彭嘉雄, 张天序: 随机离散图象的统计模型研究, 自动化学报, Vol.10, No.1, pp.16-21, 1984.
- [8] P. Swerling: Statistical properties of the contours of random surfaces, IRE Trans., Vol. IT-8, No.4, pp.315-321, 1962.
- [9] A. P. 塞奇, J. L. 梅尔萨: 估计理论及其在通讯与控制中的应用, 科学出版社, pp.76-82, 1978.
- [10] T. Asseli: Stochastic Processes and Estimation Theory with Applications, John Wiley & Sons, pp.36-69, 1979.

## COMPOUND ORDER FILTERING FOR BINARY SEQUENCE

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86  
pp 76-81

[English abstract of article by Wu Minjin [0702 2404 6855] of East China Normal University]

[Text] The distribution functions and statistical correlation properties of compound order filtering for binary sequence (i.i.d.) are investigated. Their applications to waveform analysis and image processing are also discussed. (Paper received Apr 84, finalized Aug 85.)

### REFERENCES

- [1] 万嘉若、吴敏金: Minkowski结构运算与顺序滤波, 自动化学报, No.1, 1984.
- [2] T. S. Huang: Two-Dimensional Digital Signal Processing I, Wiley, New York, 1981.
- [3] J. Serra: Stereology and Structuring Elements, Journal of Microscopy, 1972.
- [4] 吴敏金: 复合极值的统计特性及其应用, 华东师大学报, No.2, 1985.
- [5] H. A. David: Order Statistics, Wiley, New York, 1970.
- [6] 吴敏金: 递归算法与复合极值分布, 上海市计算机应用资料汇编, 第十期.

## ACCURATE SOLUTION OF ELLIPTICAL AND CYLINDRICAL STRIPLINES AND MICROSTRIP LINES

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86  
pp 82-88

[English abstract of article by Zeng Lingru [2582 0109 0320] of Beijing Institute of Tracking Telemetry and Control]

[Text] Accurate solutions of elliptical and cylindrical striplines and microstrip lines are presented. The geometric figures of the elliptical and cylindrical striplines are conformally transformed into asymmetric and symmetric planar striplines, and the elliptical and cylindrical microstrip lines into planar microstrip lines, yielding the formulae for exactly calculating characteristic impedances of the six lines, of which one is new. (Paper received Nov 84, finalized Apr 85.)

### REFERENCES

- [1] Wang Yen-Chu: IEEE Trans., Vol. MTT-26, p.20, Jan. 1978.
- [2] Joshi, K. K. and Das, B. N.: IEEE Trans., Vol. MTT-28, p. 381, April 1980.
- [3] Rao, J. S. and Das, B. N.: IEEE Trans., Vol. MTT-27, p.299, April 1979.
- [4] Byrd, P. F. and Friedman, M. D.: Handbook of Elliptic Integrals for Engineers and Physicists, 1954.
- [5] Hilberg, W.: IEEE Trans., Vol. MTT-17, p.259, May 1969.
- [6] Cohn, S. B.: IRE Trans., Vol. MTT-2, p.52, July 1954.
- [7] Waldron, R. A.: IEEE Trans., Vol. MTT-12, p.123, 1964.
- [8] Richardson, J. K.: IEEE Trans., Vol. MTT-15, p.130, Feb. 1967.
- [9] Wheeler, H. A.: IEEE Trans., Vol. MTT-13, p.172, Mar. 1965.
- [10] Schneider, M. V.: B. S. T. J., Vol. 48, p.1421, May-June 1969.

## A QUASI-LINEAR ANALYSIS OF PHASE LOCKED LOOPS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86 pp 89-94

[English abstract of article by Tian Xiaowen [3944 1321 2429] of Chengdu Institute of Radio Engineering]

[Text] A new model of PLLs is given. Linear analysis of PLLs can be developed in a larger range with the new model. The analysis gives enough precision for engineering use for a PLL with arbitrary characteristic phase detector  $g(\varphi)$ , which runs in whole positive slope range of  $g(\varphi)$ . (Paper received Aug 84, finalized Jul 85.)

### REFERENCES

- [1] W. C. Lindsey: Synchronization System in Communication and Control, Prentice-Hall, Englewood Cliffs, NJ, 1972, Chap. 4.
- [2] A. J. Viterbi: Acquisition and tracking behavior of phase locked loops, Proceeding of the Symposium on Active Networks and Feedback Systems, April 1960. Symposia Series, Vol. X, pp. 583-619.
- [3] F. M. Gardner: Phaselock Techniques, New York, John Wiley, 1979, second edition, Chap. 4.
- [4] 成都电讯工程学院一系:《锁相技术》讲义, 第11章, 1982年12月.

## LASER RECRYSTALLIZATION OF MOCVD Poly-GaAs ON INSULATING SUBSTRATES

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86 pp 110-113

[English abstract of article by Bao Ximao [7637 1585 5399], et al., of Nanjing University, Jiangsu]

[Text] Polycrystalline GaAs films are grown successfully on insulating substrates by MOCVD technique. The film is flat and bright, close in texture, and has stoichiometry of GaAs. The poly-GaAs films were recrystallized with grain size changed from 200Å to to  $\mu\text{m}$  when scanned by CW Ar<sup>+</sup> laser beam. The schottky barrier diodes are fabricated on the laser recrystallized GaAs film. (Paper received Jul 84, finalized Jan 85.)

### REFERENCES

- [1] J. F. Gibbons and K. F. Lee: IEEE Vol. EDL-1 p. 6, 1980.
- [2] 古川勝二郎, 电子材料, No. 22, p. 105, 1983.
- [3] 邹世昌、沈宋雅等, 电子学报, Vol. 11, No. 5, p. 1, 1983.
- [4] 鲍希茂、柳承恩等, 南京大学学报, Vol. 2, p. 229, 1983.
- [5] H. M. Manasevit and W. I. Simpson: J. Electronem. Soc., Vol. 116, p. 1725, 1969.
- [6] T. Nakanisi, T. Udagawa et al.: J. Crystal Growth, Vol. 55, No. 1, p. 255, 1981.

# THERMOELECTRIC POWER MEASUREMENT OF AMORPHOUS III-V COMPOUNDS SEMICONDUCTORS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86  
pp 114-116

[English abstract of article by Liu Xianghui [2692 5980 2037] of Shanghai Institute of Metallurgy, Academia Sinica]

[Text] Using measurements of the thermopower and DC conductivities, the electrical properties of thin films GaAs, GaP and InP which rendered amorphous by bombardment with rare gas ions are investigated. It is shown that ion beam bombardment amorphization is an advantageous technique for studying and understanding the fundamental process in the amorphous compounds semiconductors. (Paper received Dec 84, finalized Oct 85.)

## REFERENCES

- [1] A. Gheorghiu, M. L. Thèye: *J. Non-Cryst. Solids*, Vol. 35/36, p. 307, 1980.
- [2] M. L. Thèye, A. Gheorghiu, H. Launois: *J. Phys. C: Solid State Physics*, Vol. 13, p. 6569, 1980.
- [3] R. T. S. Shiah et al.: *Can. J. Phys.*, Vol. 55, p. 265, 1977.
- [4] J. Stuke: *Proc. of Intern. Conf. on Low-Mobility Materials*, Eilat, Israel, p.193, 1970.
- [5] W. Beyer, J. Stuke: *J. Non-Cryst. Solids*, Vol. 8-10, p. 321, 1972.
- [6] D. I. Jones et al.: *Phil. Mag.*, Vol. 36, No. 3, p.541, 1977.
- [7] W. Beyer et al.: *Solar Energy Materials*, Vol. 9, p.229, 1983.
- [8] X. C. Deng, X. H. Liu et al.: *Appl. Phys. A*, Vol. 33, p.29, 1984.
- [9] R. Pfeilsticker et al.: *Nucl. Instr. Methods*, Vol. 182/183, p.603, 1981.
- [10] N. F. Mott, E. A. Davis: *Electronic Processes in Non-Crystalline Materials*, Clarendon Press, Oxford, p.32, 1979.

## THE MICROWAVE MIXER WITH IMAGE RECOVERY USING DIELECTRIC RESONATORS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86  
pp 117-119

[English abstract of article by Ao Faliang [2407 4099 5328] of Guilin Institute  
of Electronical Technology, Guilin, China]

[Text] The microwave mixer with image recovery using dielectric resonators at X-band is presented. The design method, the real circuit and the experimental data for comparison are all discussed. The results show that the signal conversion loss is reduced by about 1dB, and the image to signal conversion loss ratio is more than 25dB. With simple circuit construction and adjustment methods, it is suitable for microwave receiver applications. (Paper received Sep 84, finalized Sep 85.)

### REFERENCES

- [1] W. L. Pritchard: IRE Trans., Vol. MTT-3, pp. 37-39, Jan. 1955.
- [2] K. M. Johnson: IEEE Trans., Vol. ED-15, pp. 430-450, July 1968.
- [3] 李炳华,《固体微波》, No.1, pp. 8-11, 1979.
- [4] 王德仪等,《微波器件与电路》, p. 48, 江苏科技出版社, 1981年版。
- [5] D. Kajfez: MSN, pp 133-140, June 1982.
- [6] 吴万春,《微波网络》, 西北电讯工程学院, 1975年版。
- [7] 戴发良, 张德瑞,《通信学报》, Vol.8, No.2, pp. 79-83, 1985.
- [8] 吴万春,《集成固体微波电路》, p.161, 国防工业出版社, 1981年版。
- [9] 戴发良, 张德瑞, 推荐一种介质谐振器尺寸的同率计算方法, 1984年中国电子学会通讯学会微波通讯技术学术会议论文。

## OHMIC CONTACT ON HIGH RESISTIVITY N-Si

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14, No 3, May 86  
pp 120-122

[English abstract of article by Chen Cunli [7115 1317 4409] of Department of Physics, Nanjing University, and Chen Zhengfu [7115 2973 1133] et al., of Shanghai Electronic Devices and Materials Works]

[Text] Using a silver head electric soldering iron, the alloy consisting of In, Au, Sb and Ni in the ratio of 91:7:1:1 is directly smeared on the silicon wafer, which is then annealed at 450°C. Good quality ohmic contact is obtained even when the silicon resistivity is as high as 600Ωcm. The specific contact resistivity of metal to N-Si is calculated as a function of doping concentration and compared with experimental results. This contacting technique is successfully applied to the measurement of impurity compensation. (Paper received Nov 84, finalized Jun 85.)

### REFERENCES

- (1) 陈存礼, 范仁永, 半导体学报, Vol. 4, No. 5, p. 502, 1983.
- (2) 陈存礼, 电子学报, Vol. 12, No. 3, p. 105, 1984.
- (3) 陈存礼, 稀有金属, Vol. 20, No. 5, p. 53, 1980.
- (4) A.Y.C. Yu: Solid-State Electronics, Vol. 13, No. 2, p. 239, 1970.
- (5) 陈存礼, 物理学报, Vol. 33, No. 9, p. 1314, 1984.

/7358

CSO: 4009/1065

IMMUNOHISTOCHEMICAL OBSERVATION OF CARDIONATRIN-LIKE SUBSTANCE IN RAT LUNG

Beijing BEIJING YIKE DAIKUE XUEBAO [JOURNAL OF BEIJING MEDICAL UNIVERSITY] in Chinese Vol 18, No 2, 18 May 86 pp 81-82

[English abstract of article by Sun Minzhi [1327 2404 0037], et al., of Department of Histology and Embryology]

[Text] Highly specific anti-human atrial natriuretic peptide serum and peroxidase-antiperoxidase (PAP) immunohistochemical technique were used to demonstrate the distribution of cardionatrin in rat lung. Cardionatrin-like substance is found in part of the muscle cells of the wall of pulmonary veins and in some cells of alveolar septa. In the muscle cells it is located in the cytoplasm around the nucleus. The cells in a alveolar septa are mostly in groups. They are large, round or irregular. Their cytoplasm contains many granules of cardionatrin-like substance. The nature of such cell is to be determined.

REFERENCES

1. 孙敏之等. 大鼠心脏心钠素免疫组织化学观察. 北京医学院学报 1984; 18 (4):265.
  2. Tang J, et al. Characterization and localization of atriopeptin in rat atrium. *Peptides* 1984; 5:1173.
  3. Tang J, et al. Depressor and natriuretic activities of several atrial peptides. *Regulatory Peptides* 1984; 9:83.
  4. Tang J, Xie CW. Cardionatrin-A new brain, heart and lung peptides (plenary lecture) 7th conference of neuroscience, Hong Kong 1985; P4a.
  5. Sternberger LA. *Immunocytochemistry*. 2nd ed. John Willy and sons Inc NY, 1979:124-126.
- (本文图见插图第5页)

COMPUTER ANALYSIS BY LENS ARRAY FOR UNIFORM ILLUMINATION

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 2,  
20 Feb 86 pp 65-70

[English abstract of article by Chen Zezun [7115 3419 1415], et al., of Shanghai  
Institute of Optics and Fine Mechanics, Academia Sinica]

[Text] It is advantageous to use lens array for uniform illumination of high-power laser targets<sup>1</sup>. By using the computer analysis of the optical field on the targets, the characteristics of this way have been studied. In the present report, we propose a star-shaped arrangement of the concentricity deviation of the lens array elements. This enables us to concentrate the two-dimensional interference pattern and can meet the requirements of the uniformity and experiments.

STUDY ON TWO PHYSICAL MECHANISMS FOR HIGH ORDER COHERENT RAMAN RADIATION

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 2,  
20 Feb 86 pp 71-75

[English abstract of article by He Guangsheng [6378 0342 3932], et al., of  
Shanghai Institute of Optics and Fine Mechanics, Academia Sinica]

[Text] High order coherent Raman radiation caused by two different mechanisms in the stimulated Raman scattering experiments have been studied. One is the cascade stimulated scattering process, the other is Raman-resonance enhanced four-wave mixing which is characterized by phase matching condition and causes a hollow ring distribution in the near-field. Experimental results judgement using calcite sample have shown that these two physical processes can appear separately or simultaneously depending on the experimental conditions.

GAIN CHARACTERISTICS OF FREE-ELECTRON LASERS USING SMITH-PURCELL EFFECT

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13,  
No 2, 20 Feb 86 pp 80-85

[English abstract of article by Zhang Dake [1728 1129 0668] of Shanghai Institute  
of Optics and Fine Mechanics, Academia Sinica]

[Text] Coupled-mode approach and electron Bloch equations are combined to  
calculate the gain of free-electron lasers using Smith-Purcell effect in the  
gain quantum model. The possibility of increasing gain by changing the spa-  
tial frequency of the grating is studied.

# INSTRUMENTATION FOR RAPID DETERMINATION OF REFLECTIVE AND TRANSMISSIVE SPECTRA

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 2, 20 Feb 86 pp 99-103

[English abstract of article by Wang Bingkui [3769 3521 1145], et al., of Fudan University]

[Text] An effective and precision apparatus for rapid determination of optical reflective and transmissive spectra is described. By using a rapid rotating optical fiber to sample the incident and reflected or transmitted light beams respectively and feedback of the incident beam intensity to monitor the gain of the photomultiplier for keeping the incident photo-current under constant level, the measured signal gives the transmissivity or reflectivity directly. Besides, due to rapid scanning of the sampled signals the requirement on the steadiness of the light source is not critical. The relative accuracy of the measurements in the range of 410nm to 650nm is less than 2 percent and the time for scanning the complete visible spectrum is 2 minutes.

# LARGE CURRENT RECTANGULAR PULSED LASER POWER SUPPLY

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 2,  
20 Feb 86 pp 112-115

[English abstract of article by Xue Bin [5641 1755], et al., of Department  
of Precision Instruments, Tianjin University]

[Text] By combining thristor switch with large power transistor, large current  
rectangular pulsed laser power supply with stable smooth top is obtained, pulsed  
current of 80A and top current fluctuation within 2 percent are achieved.

/7358

CSO: 4009/88

RELATIVE DISTRIBUTION AT FOCAL PLANE OF LOW-ORDER MODES FOR GAUSSIAN LASER BEAMS

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 6, 20 Jun 86 pp 321-327

[English abstract of article by Cheng Zhaogu [4453 0340 6253] and Wang Runwen [3769 3387 2429] of the Shanghai Institute of Optics and Fine Mechanics, Academia Sinica]

[Text] Analytic resolution for relative energy distribution at focal plane of low-order modes for Gaussian laser beams is given. The results are compared with the focal properties at far-field of single mode light for unstable cavity with different magnification  $M$ . With 80 percent of total laser energy at focal plane as the united criterion of beam divergence, calculation indicates that with stable cavity for mode-selection, one can obtain good beam quality which may be close, even superior, to that for mode-selection for unstable cavity under some conditions. Moreover, the stable cavity construction is simple, the cavity is more stable and the electro-optic efficiency is high as well.

# SELF-HEATED 20 W DISCHARGE COPPER VAPOR LASER

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13,  
No 6, 20 Jun 86 pp 334-337

[English abstract of article by Liang Baogen [2733 1405 2704], et al., of Shanghai Institute of Optics and Fine Mechanics, Academia Sinica]

[Text] Output characteristics of our self-heated discharge copper vapor laser are reported. The maximum average power is 20.5 W with an efficiency of 1.5 percent. Luminescence performances of the device are measured and discussed.

A METHOD OF SEARCHING FOR WORKING MATERIALS OF OPTICALLY PUMPED FIR LASERS

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 6, 20 Jun 86 pp 341-347

[English abstract of article by Xu Fuyong [6079 4395 3057], et al., of Department of Radio Physics and Computer Science, Lanzhou University]

[Text] The mechanism of the known working materials for optically pumped FIR lasers is explained on the basis of the physical model of di-group vibration and linear tri-group vibration. Mathematical derivation shows a fairly good result. Based on this result a method of searching for working materials of optically pumped FIR lasers is obtained.

LASER-EXCITED FLUORESCENCE SPECTRA OF OH RADICALS IN  $C_2H_2$ /AIR FLAME

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 6, 20 Jun 86 pp 348-350

[English abstract of article by Wang Dadi [3769 1129 0966] and Jiang Zhankui [5592 0594 7608] of Department of Physics, Jilin University]

[Text] Laser-excited UV fluorescence spectra of OH radicals at transition  $A^2\Sigma^+ - X^2\Pi$  in  $C_2H_2$ /air flame have been measured. All lines in 0-0, 1-0, 2-1 bands obtained are in very good agreement with those by other methods, thus the present work provides useful data for temperature detection of flame. We have also determined the OH concentration distribution at different heights of the flame.

DIODE LASER DERIVATIVE SPECTROSCOPIC TECHNIQUE AND STUDY OF  $\text{CH}_3\text{CH}\nu_4$  BAND

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 6, 20 Jun 86 pp 351-355

[English abstract of article by Yang Xueming [2799 1331 2494], et al., of Dalian Institute of Chemical Physics, Academia Sinica]

[Text] Diode laser derivative spectroscopy of  $\text{CH}_3\text{CN}\nu_4$  band is reported here for the first time. About 120 lines of  $\nu_4$  band of the molecule were recorded by means of the second order derivative spectroscopic technique. With an improved least square fitting technique, improved parameters of  $\nu_4$  band were obtained. And some properties of diode derivative spectroscopic technique were discussed.

# GROWTH OF $K_3Pr(PO_4)_2$ CRYSTALS

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 6,  
20 Jun 86 pp 362-364

[English abstract of article by Hong Guangyan [3163 1639 6056], et al., of  
Changchun Institute of Applied Chemistry, Academia Sinica]

[Text] The crystals of  $K_3Pr(PO_4)_2$  have been grown from a KF-KCl flux. The influence of the flux evaporation on the crystal yield is given. The chemical analysis and X-ray diffraction pattern confirmed that the crystal was  $K_3Pr(PO_4)_2$ . The infrared, absorption and fluorescence spectra have been determined.

DETECTION SYSTEM FOR TIME RESOLVED WEAK SIGNALS IN LASER SPECTROSCOPY

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13,  
No 6, 20 Jun 86 pp 365-367

[English abstract of article by Ye Lili [0673 7787 7787], et al., of Anhui  
Institute of Optics and Fine Mechanics, Academia Sinica]

[Text] A transient digitizer is combined with a multichannel analyzer to form a multichannel averaging system. This system has faster response time and higher accumulation velocity than normal multichannel signal averagers. It has been used in some simulating experiment and laser-induced fluorescence measurement of CH<sub>4</sub>.

INVESTIGATION OF WHITE LIGHT HOE--REFLECTION HOLOGRAPHIC LENS FOR VISUAL DISPLAY APPLICATIONS

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 13, No 6, 20 Jun 86 pp 368-372

[English abstract of article by Xu Kunxian [1776 2492 6343] of Shanghai Institute of Laser Technology]

[Text] Off-axial reflection holographic visual display elements which records in dichromated gelatin (DCG) deposited on planar substrate of glass has been developed for pilot headup display (HUD). Important image characteristics such as diffraction efficiency, aberrations, dispersion, distortion and optical transfer function (OTF) etc for the off-axial reflection holographic lens are analysed. Preparation and processing of DCG film and several important techniques for obtaining high quality holographic lens are recommended.

/7358

CSO: 4009/86

ON THE DIOPHANTINE EQUATION  $p^2-2q^2=-1$

Chengdu SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)] in Chinese No 2, 1986 pp 1-9

[English abstract of article by Qu Minghua [1448 2494 5478]]

[Text] This paper considers the equation

$$p^2-2q^2=-1, \quad p, q \text{ prime} \quad (1)$$

which arose by Grescenzo P. Using some properties of pell number, we have proved following theorems.

Th 1. Let  $q \equiv 1 \pmod{8}$  is a prime. If  $q=u^2+2^2$  and  $8 \nmid u$  then for arbitrary prime  $p$ ,  $(p, q)$  is not a solution of equation (1)

Th 2. 1) If  $p=u^2+2v^2 \equiv 9 \pmod{16}$  is a prime and  $8 \mid u$  then for arbitrary prime  $q$   $(p, q)$  is not a solution of equation (1)

2) Let  $p=c^2+128d^2 \equiv 17 \pmod{32}$  is a prime. Hence  $p=a^2+64b^2$ . If  $b+d \equiv 1 \pmod{2}$ , then for arbitrary prime  $q$ ,  $(p, q)$  is not a solution to equation (1).

Th. 5. (1) has only three solutions, which satisfy that  $p, q < 10^{15}$ :  $(7, 5)$ ,  $(41, 29)$ ,  $(63018038201, 44560482149)$  (Paper received 12 Jan 85.)

REFERENCES

- [1] Grescenzo P. Advance Math 17(1975), 25—29.
- [2] 柯召、甄万迪. 组合论(上册). 科学出版社, 1984, 132.
- [3] V.Thebault. Sur des suites de pell. Mathesis 65(1956), 390—393.
- [4] P.Barrucand and H.Cohn. J.Reine Angew Math. 238(1969) 67—70.
- [5] Erich Hecke. Lectures on the theory of algebraic numbers. Springer-Verlag New York Inc. 1981 196.
- [6] Emma Lehmer. J.Reine Angew Math 268/269(1974), 294—301.

# MONTE CARLO SIMULATION OF THE PRIOR PROBABILITY ESTIMATION IN DDR

Chengdu SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)] in Chinese No 2, 1986 pp 85-92

[English abstract of article by Zhang Yongke [1728 3057 4430] and Guo Xiaofeng [6753 2556 1496]]

[Text] In this paper, two methods (SAMK and SAMD) of estimating the prior probability in DDR (Decission-Directed Receiver) are discussed and compared in detail. The experimental simulations are made on both methods by Monte Carlo technique when SNR is not too small, satisfactory results are obtained. The improved SAMD method presented in this paper showed its simplicity in simulation. (Paper received 31 Jan 85.)

## REFERENCES

- [1] L.D.Davisson and S.C.Schwartz, IEEE Trans., IT-16(1970),270.
- [2] D.Kazakos and L.D Davisson, IEEE Trans., IT-26(1980),113
- [3] J.Sacks, Ann.Math.Stat., 29,(1958),373
- [4] 中国科学院计算中心概率统计组, 概率统计计算, 科学出版社, 1983.
- [5] Jalalinasab and J.A.Bucklew, IEEE Trans., IT-29(1983),619.
- [6] D.D.Falconer, IEEE Trans., IT-17(1971), 336.
- [7] Z.Y.Young and G.Coraluppi, IEEE Trans., IT-16(1976),258.

## Mathematics

### DISCRETE PHENOMENA IN UNIQUE SOLVABILITY FOR COURSAT'S PROBLEMS OF HYPERBOLIC SYSTEM OF SECOND ORDER

Guangzhou ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI] in Chinese No 2, May 85 pp 11-17

[English abstract of article by Wu Ciqian [0702 5417 3383, Xuan Qiwo [8983 0796 3087] of the Computer Science Department, and Zhong Jukang [6988 6880 1660] of the Huanan Institute of Technology]

[Text] We have proved that the unique solvability for a class of Goursat's problems of the hyperbolic system of second order disappears if and only if the parameters of the system satisfy a certain coupling relation. (Paper received May 1984)

#### References:

- [1] F. Treves, *Proc. Amer. Math. Soc.* 46(1974), 229—233.
- [2] 华罗庚、吴兹潜、林伟, 二阶两个自变数两个未知函数的常系数线性偏微分方程组, 科学出版社, 1979.
- [3] 吴兹潜, 褚启沃, 函数矩阵方程与波的有限传播法, 中山大学学报(自然科学版) 1984, 1.

## CONSTRUCTION, APPLICATION OF CLASS FUZZY CONTROL MODEL

Guangzhou ZHONGSHAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS SUNYATSENI] in Chinese No 2, May 85 pp 38-44

[English abstract of article by Lin Deheng [2651 1795 5899], Chen Jieru [7115 3381 1172], and Lin Xunliang [2651 8113 0081] of the Radio Electronics Department]

[Text] A class Fuzzy control model which is constructed by means of standardization method is described. It is very convenient that the model is implemented on microcomputer and the model is selected according to various requirements of processes. Examples of application of the model and the results obtained from digital simulation are also given. (Paper received in August 1984.)

### References:

- [1] Zadeh, L.A., *Information and Control*, 8(1965), 338.
- [2] King, P.J. and Mamdani, E.H., *Automatica*, 13(1977), 235.
- [3] Tong, R.M., *Automatica*, 13(1977), 559.
- [4] 李宝毅、刘志俊, 自动化学报, 6(1980), 25.
- [5] 菅野道夫, 模糊集合与模糊逻辑在控制中的应用, 叶耕中译自《计测与控制》, 18(1979), 2.
- [6] 应行仁, 模糊数学, 4(1982).

/9365

CSO: 4009/1075

FINITE-AMPLITUDE STABILITY OF POISEUILLE FLOW IN A CIRCULAR PIPE

Tianjin TIANJIN DAXUE XUEBAO [JOURNAL OF TIANJIN UNIVERSITY] in Chinese No 1, Jan 86 pp 64-72

[English abstract of article by Zhao Gengju [6392 5087 1133] of The Mechanics Department]

[Text] The small finite axisymmetrical disturbance in a Poiseuille flow in a circular pipe is studied. The results indicate that the finite amplitude disturbance is stable and no threshold amplitude is present. (Paper received 22 Oct 84.)

REFERENCES

- [1] 周恒, *Proc. R. Soc. Lond. A*381 (1982), 407—418.
- [2] Sexl, T., *Ann. Phys.*, (1927), 83, 835.
- [3] Gill, A.E., *J. Fluid Mech.* (1956), 21, 145.
- [4] Davey, A. & Drazin, P.G., *J. Fluid Mech.* (1969), 36, 209.
- [5] Lessen, M., Sadler, S.G. & Liu, T.Y., *Phys. Fluids*, (1968), 11, 1404.
- [6] Tatsumi, T., *J. Japan Phys. Soc.* (1952), 7, 495.
- [7] Davey, A., *J. Fluid Mech.* (1971), 45, 701—720.
- [8] Reynolds, W.C. & Potter, M.C., *J. Fluid Mech.* (1967), 27, 465.
- [9] Itoh, J., *J. Fluid Mech.* (1977), 82, 469—479.
- [10] Leite, R.J., *J. Fluid Mech.* (1959), 5, 81.
- [11] 周恒, 赵耕夫, *力学学报*, (1982), 3.
- [12] Orszag, S.A. & Kells, L.C., *J. Fluid Mech.* (1980), 96, 159—207.
- [13] Swinney, H.L. & Gollub, J.P., *Hydrodynamic Instabilities and the Transition to turbulence.*, (1981), 69—70, Springer-Verlag.

THE SOURCE AND QUANTITATIVE ESTIMATION OF THE SAND ACCUMULATION IN CHANNEL AT THE BAR OF THE RIVER MOUTH OUTSIDE SHANTOU PORT

Beijing HIAYANG YU HUAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 17, No 1, Jan 86 pp 13-24

[English abstract of article by Lin Baorong [2651 1405 2837], et al., of Institute of Oceanology, Academia Sinica, Qingdao]

[Text] Sand sources of the bar at the river mouth outside the Shantou [3073 7333] Port and the dredged channel are further discussed and the accumulation is calculated roughly based on other studies and the data recently acquired. The results revealed that the bar at the river mouth outside Shantou Port just overlaps the modern ebb delta and the delta of the Xinjinxi River based on the ancient longshore bar. The development, growth and decline of it are closely related to the characteristics of the sand carried there from Xinjinxi River and by the wave and the tidal current.

The bar at the river mouth has turned to be declining after dredging a channel through it according to the sediment patterns. The volume of the sediment is on the decrease from the river mouth to the channel on the bar, and the heavy minerals can be divided into three zones: titanite, magnetite, zircon → epidote, hornblende → biotite in accordance with their specific gravities and shapes.

Its properties show that the sand was transported to the river mouth from the Xinjinxi River. Comparison of the historic charts (1907-1979) show that average annual accumulation in this area is about 560,000 m<sup>3</sup>, that on the east side of the channel accounts for 87.3 percent. However, accumulation on the west side tends to get faster, indicating that the sand was transported from east to west.

Various informations testify that the sand accumulated in the dredged channel is transported from shoal in the east side. At present, the bar of the river mouth is under a dynamic paraequilibrium with a slight accumulation. However, after the channel is dredged, the channel will be silted up gradually by the sand. The volume of the silt deposit is related to the width and depth of the dredged channel. Provided that the channel is 80m wide and -5.5 m deep, the accumulation may be estimated at 5000,000-600,000 m<sup>3</sup>/a. (Paper received 20 Oct 83.)

REFERENCES

- [1] 成都地质学院队北队, 1978. 沉积岩(物)粒级分析及应用. 地质出版社, 第3页.
- [2] Сафьянов, Г. А., 1978. Береговая зона океана в XX веке. Изд. «Мысль», стр. 33.

# THE SEDIMENTARY ENVIRONMENTS AND CHARACTERISTICS OF THE CORAL REEF OF THE YONGXING ISLAND

Beijing HIAYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 17, No 1, Jan 86 pp 36-44

[English abstract of article by Wang Guozhong [3769 0948 1813], et al., of Institute of Marine Geology, Tongji University, Shanghai]

[Text] The climate of Yongxing [3057 5281] Island, a well developed reef areas in the Xisha Islands in the South China Sea, is that of tropical monsoon. This coral reef is based on the residuum of granite-gneiss and has been developing continually since Miocene epoch.

Recent coral reef crest of the Yongxing Island is in elliptical form and ring-like. The facies on the northeast and the south-west sides are generally alike, but differ in width, number of coral genera and products of carbonate sediments. They are distributed asymmetrically as a result of asymmetrical monsoons, currents and submarine relief, while the distribution of the coral reefs in the Pacific are controlled by the trade wind.

The recent coral reef crest of the Yongxing Island appears in the following facies: the autochthonous coral reef rock facies, the reef marginal shoal gravel-boundstone facies, the reef flat sand-gravel with patch reef facies, and the cay gravel-sand facies. This reef complex is of a carbonate mound surrounded by the autochthonous reef rocks and biendstones on the reef crest. It belongs in category to the table reef. Though the sediments in the coral reef areas of the Pacific are predominantly algal debris, yet those of the Yongxing Island are absolutely dominated by the scleractinian coral and their debris. (Paper received 14 Mar 83.)

## REFERENCES

- [1] 王崇友、何希贤、袁松余, 1979. 西沙群岛西永一井碳酸盐岩地层与微体古生物的初步研究。石油实验地质 1: 23—38。
- [2] 伍辉民、陈伟球, 1977. 我国西沙群岛的植物和植被。科学出版社, 127 页。
- [3] 杨宗岱, 1982. 中国海草的生态学研究。海洋科学 2: 34—37。
- [4] Jordan, C. F., 1978. Tropical lagoon: sedimentation In: The Encyclopedia of Sedimentology (Fairbridge, R. W. and J. Bourgeois, ed.). Dowden, Hutchinson and Ross, Inc. pp. 821—828.
- [5] Levorsen, A. I., 1967. Geology of Petroleum. (2nd edition). W. H. Freeman Company, San Francisco. 724pp.
- [6] Mergner, H. and G. Scheer, 1974. The physiographic zonation and the ecological conditions of some South Indian and Ceylon coral reefs. In: Proceeding of the Second International Coral Reef Symposium. Great Barrier Reef Committee, Brisbane. pp. 3—30.
- [7] Milliman, J. D., 1974. Marine Carbonates. Springer-Verlag, Berlin, Heidelberg, New York, 375pp.
- [8] Tracey, J. I., J. H. S. Ladd and J. E. Hoffmeister, 1948. Reefs of Bikini, Marshall Island. Bull. of the Geol. Soc. Amer. 59: 881—899.

/7358

CSO: 4009/1070

A NEW METHOD FOR THE SYNTHESIS OF 2-METHOXYESTRADIOL\*

Chengdu SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)] in Chinese No 2, 1986 pp 114-116

[English abstract of article by Chen Shuhua [7115 0647 5478] et al.]

[Text] A new effective method for the synthesis of 2-methoxyestradiol is described. Estradiol was brominated with NBS to give 2-bromoestradiol (II) in 36 percent yield and subsequent nucleophilic substitution of the bromo atom by methoxide ion under the catalysis of CuI(Or Cu<sub>2</sub>O)-Crown ether in DMF at 100-105°C afforded 2-methoxyestradiol in 84 percent yield. The overall yield in the present synthetic route is higher than those have ever been reported in literature for the same target compound. (Paper received 8 Oct 84.)

REFERENCES

- [1] P. Narasimha Rao and J. E. Burdent, SYNTHESIS, 3 (1977), 168.
- [2] 陈淑华等, STEROIDS, 40(2), 1982, 123.

/7358

CSO: 4009/1060

A PRELIMINARY EXPERIMENTAL STUDY ON THE BIOLOGICAL FIXATION EFFECT OF CHINESE-MADE MADREPORIC FEMORAL HEAD PROSTHESIS

Beijing BEIJING YIKE DAIXUE XUEBAO [JOURNAL OF BEIJING MEDICAL UNIVERSITY] in Chinese Vol 18, No 2, 18 May 86 pp 91-94

[English abstract of article by Sun Xiaoli [1327 2556 7812], et al., of Department of Orthopaedics The Third Hospital]

[Text] Chinese-made madreporic Co-Cr-Mo alloy femoral head replacement was performed on 16 adult dogs. Having evaluated the data of the function recovery of hip joint, roentgenographic changes, biomechanical testing and morphological study, the authors believe that this new-type porous hip prosthesis could give excellent bone-ingrowth self-locking biological fixation. Meanwhile, the mechanical characteristics of the bone-ingrowth fixation and their relationship with function recovery of hip joint were discussed. It is hoped that this study could serve a scientific basis for clinical application of this madreporic porous hip prosthesis.

REFERENCES

1. Freeman M. A. R. Some Disadvantages of Cemented Intramedullary Stem Fixation and Their Remedies. In: Schaldach M. Artificial Hip and Knee Joint Technology. 1st ed. Berlin Heidelberg New York: Springer-Verlag. 1979;127-137.
2. Ducheyne P. et al. Influence of a Functional Dynamic Loading on Bone Ingrowth into Surface Pores of Orthopaedic Implants. J Biomed Mater Res 1977;11:811.
3. Rostoker W. et al. Effect of an in Vivo Environment on the Strength of Bone Cement. J Biomed Mater Res Symp 1979; 13:365.
4. Dana C. M. Materials and Orthopaedic Surgery. 1st ed. Baltimore: The Williams & Wilkins Company. 1979;507-510, 733-734.
5. 孙训芳等 材料力学 上册 第1版 北京: 人民教育出版社 1964; 68-78.

(本文图 1, 3, 5-13 见插图第 7 页)

/7358

CSO: 4009/1068

INFLUENCE OF HEAT TREATMENT ON THE SUPERMOLECULAR STRUCTURES OF POLYETHYLENE-2.6 NAPHTHALATE

Chengdu SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)] in Chinese No 2, 1986 pp 58-62

[English abstract of article by Zhu Jumu [2612 1446 2606], et al.]

[Text] The crystallinity, the crystalline size and the interchain distance of amorphous have been calculated using the computer based multipeak resolution method to resolve the x-ray diffraction spectra of polyethylene-2.6 naphthalate (PEN -2.6) obtained at different heat treatment temperatures. The crystallinity calculated is consistent with those measured by the density method. By extrapolating the regressive curve of the density and the crystallinity to 100 percent and 0 percent, the same density as those presented in reference is obtained[1]. The relation curves of the crystallinity versus heat treatment temperature show that, when rising the heat treatment temperature, the crystallinity of PEN-2.6 increases, but the interchain distance of amorphous at lower temperature decreases. (Paper received 24 Nov 84.)

REFERENCES

- [1] Z. Mencik, C.A., 67(1967), 15849r.
- [2] 朱居木, 杜勇, 四川大学学报(自然科学版), 4(1985), 41.
- [3] L.E. Alexander, X-Ray Diffraction Methods in Polymer Science, John Wiley & Sons Inc 1969, 137-188.
- [4] F.W. Jones, Proc. Roy. Soc. 166A(1938), 16.
- [5] 中国科学技术大学高分子物理教研室, 高聚物的结构与性能, 科学出版社, 1983.

# THE ROLE OF GRAPHITIZATION DURING SINTERING OF DIAMOND POWDER AT HIGH PRESSURE

Chengdu SICHUAN DAXUE XUEBAO (ZIRAN KEXUE BAN) [JOURNAL OF SICHUAN UNIVERSITY (NATURAL SCIENCE EDITION)] in Chinese No 2, 1986 pp 63-71

[English abstract of article by Li Boxun [2621 0130 8113], et al.]

[Text] Diamond powder was sintered with the aid of Ni-Ti alloy binder at 7.7 G pa and 1300-1700C. For the resulting sintered bodies the microstructure was observed, and the analysis of phase structure, phase composition was performed, the densification, wearing resistance and compressive strength were measured. The results showed that diamond graphitization is a key stage in sintering process, it plays an important role in the formation of bonding between diamond particles with alloy binder and the direct diamond-diamond bonding in sintered bodies. (Paper received 18 Feb 85.)

## REFERENCES

- [1] M. Akaishi, H. kanda et al. J. Mater. Sci., 17 (1982), 193
- [2] 四川大学超硬材料研制組等, 四川省超硬材料經驗交流会資料, 1977
- [3] S. Naka, A. Tsuzuki et al, J. Mater Sci., 19 (1984), 259
- [4] В. П. успелева, В. Г. Делеви, И. Я. Порошковая Металлургия, 1(1984), 66.

# STUDIES OF THE ELECTRICAL PROPERTIES OF FeWB METAL GLASS AT HIGH TEMPERATURES

Tianjin TIANJIN DAXUE XUEBAO [JOURNAL OF TIANJIN UNIVERSITY] in Chinese No 1, Jan 86 pp 50-55

[English abstract of article by Lu Qi [0712 2475], et al., of The Department of Physics]

[Text] The electrical properties of FeWB metal glass at high temperatures have not been reported so far. The electrical properties of  $(\text{Fe}_{100-X}\text{W}_X)_{84.5}\text{B}_{15.5}$  ( $X=2,4,6,8,10$ ) metal glass were studied with a self-designed measuring device. Measuring errors inherent in normal measurements were considerably reduced and the curve of relative change of electrical relaxation effect of metal glass was found to be the main cause of the deviation of the electric resistivity  $\rho(T)$  of metal glass from the linear relationship. The concept of "disorder sit" of scattering electrons in the glass was adopted to explain the drop off during the structural relaxation. Ziman's theory holds good only when the effect of structural relaxation was ignored. The Debye temperature  $\theta_D$  of the material was not over 300K. (Paper received 24 Apr 84.)

## REFERENCES

- [1] M.Sostarich, et al.; Proc. Int. Conf. on Rapidly Quenched Metals 4th (Sendai, 1981), 1109
- [2] 詹文山, 等; Proc. Int. Conf. on Rapidly Quenched Metals 4th (Sendai, 1981), 1137
- [3] I.W.Donald, et al.; Proc. Int. Conf. on Rapidly Quenched Metals 4th (Sendai, 1981), 597.
- [4] B.G.Lewis, et al.; Proc. Int. Conf. on Rapidly Quenched Metals 3rd (Brighton, 1978), Vol. 2, 325
- [5] O.Dreirach, R.Evans, et al.; J. Phys. F. (1972), 709
- [6] P.J. Cote, et al.; Proc. Int. Conf. on Rapidly Quenched Metals 3rd (Brighton, 1978), Vol. 2, 62
- [7] D.J.Kim, et al; Phys. Rev., B15 (1977), 377

CYTOPROTECTIVE EFFECT OF PROSTAGLANDIN E<sub>2</sub> ON PANCREATIC ISLET  $\beta$ -CELL OF ALLOXAN-INDUCED DIABETIC RATS

Shanghai SHENGLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese Vol 38, No 2, Apr 86 pp 191-201

[English abstract of article by Wang Jinlin [3076 6930 2651], et al., of Research Laboratory in Physiology of Digestion and Reproduction, Institute of Basic Medical Sciences, Beijing Medical University]

[Text] An experimental diabetes model was produced by subcutaneous injection of alloxan monohydrate in a dose of 200 mg/kg. Prostaglandin E<sub>2</sub> (PGE<sub>2</sub>) administered intraperitoneally 15 minutes prior to alloxan was able to decrease the incidence of alloxan-induced diabetes from 75 percent of the control to 12.5 percent and to decrease the mean average of plasma glucose concentration from 498.0 $\pm$ 86.6 mg% of the control to 141.9 $\pm$ 30.5 mg% at 72 hours after the injection of alloxan.

The protective effect of PGE<sub>2</sub> was dose dependent. The oral glucose tolerance test at 120 hours after the injection of alloxan showed that the curves were markedly reduced in the rats pretreated with PGE<sub>2</sub>. The microscopic section of the pancreatic islets of the rats that were pretreated with PGE<sub>2</sub> showed that the concentration of secretory granules in  $\beta$  cells was markedly increased as compared to the alloxan-induced diabetic rats. The result indicates that the acute damage of  $\beta$  cells caused by alloxan was milder in the rats pretreated with PGE<sub>2</sub>. From the functional as well as morphological investigation, we suggest that PGE<sub>2</sub> might have a cytoprotective effect on the  $\beta$  cells of the pancreatic islets in rats. (Paper received 13 Aug 84, finalized 14 Nov 84.)

REFERENCES

- [1] Robert, A. (1979). Cytoprotection by prostaglandins. *Gastroenterology*, **77**, 761-767.
- [2] Stachura, J., Tarnawski, A., Ivey, K. J., Mach, T., Bogdal, T., Sazrudrawa, J. and Klimczyk, B. (1981). Prostaglandin protection of CCl<sub>4</sub>-induced liver cell necrosis in the rat. *Gastroenterology*, **81**, 211-217.
- [3] Manafe, T. (1980). Protective effect of PGE<sub>1</sub> on diet induced acute pancreatitis in mice. *Gastroenterology*, **78**, 777-781.
- [4] 周序开(1982). 血浆(及全血)葡萄糖测定—葡萄糖氧化酶法的探讨. 中华医学检验杂志, **3**, 56-60.
- [5] Lazarus, S. S., Barden, H. and Bradshaw, M. (1962). Pancreatic beta cells and alloxan toxicity. *Archives of Pathology*, **73**, 210-222.
- [6] Gomori, G. (1950). Aldehyde fuchsin, a new stain for elastic tissue. *Am. J. Clin. Pathol.*, **20**, 665-666.
- [7] Robert, A. (1981). Current history of cytoprotection. *Prostaglandins*, **21**, (suppl.) 89-93.
- [8] 王志均(1984). 胃肠道的细胞保护. 生理科学进展, **15**(1), 5-10.
- [9] Rusini, A. A., Arcangeli, M. A. and Cahill, D. F. (1975). Studies of the alloxan toxicity on the beta cell. *Diabetes*, **24**, 516-522.
- [10] Weaver, D. C., McDaniel, M. L. and Lacy, P. E. (1978). Alloxan uptake by isolated rat islets of Langerhans. *Endocrinology*, **102**, 1847-1855.
- [11] Robertson, R. P., Gavareski, P. J., Porter, D. Jr. and Bierman, E. L. (1974). Inhibition of in vivo insulin secretion by prostaglandin E<sub>1</sub>. *J. Clin. Invest.*, **54**, 310-315.
- [12] Bresler, R., Vargas-Cordon, M. and Lebowitz, H. E. (1968). Tranycypromine: a potent insulin secretagogue and hypoglycemia agent. *Diabetes*, **17**, 617-624.
- [13] Pek, S., Tai Tung-yuan and Elster, A. (1978). Stimulatory effect of prostaglandin E<sub>1</sub>, E<sub>2</sub> and F<sub>2</sub> on glucagon and insulin release in vitro. *Diabetes*, **27**, 801-809.
- [14] Scheynius, A. and Talyedal, I. B. (1971). On the mechanism of glucose protection against alloxan diabetes. *Diabetologia*, **7**, 252-255.

RESPONSES OF HYPOTHALAMIC PARAVENTRICULAR NEURONS TO ELECTRICAL STIMULATION OF MIDBRAIN CENTRAL GRAY (CG) AND LEMNISCUS MEDIALIS (LM) IN THE RAT

Shanghai SHENGLI XUEBAO [ACTA PHYSIOLOGICA SINICA] in Chinese Vol 38, No 2, Apr 86 pp 210-215

[English abstract of article by Xing Baoren [6717 1405 0088], et al., of Department of Physiology, Second Military Medical College, Shanghai]

[Text] The experiments were performed on 28 rats immobilized with Flaxedil. Unit discharge of PVH neurons was recorded by glass microelectrode extracellularly. CG and LM in midbrain were stimulated with bipolar electrode respectively.

The activity of neurons in the PVH and its responses to brain stimulation were observed. The main results are as follows: After CG stimulation, 4 units showed antidromic response, 47 units showed orthodromic responses with different types: Type I was responsive to single stimulus, while type II was responsive only to a train of stimuli. No response to LM stimulation was observed.

These results suggest that there are two-way connections between PVH and CG, but no connection between PVH and LM could be demonstrated electrophysiologically. (Paper received 10 Dec 84, finalized 10 Apr 85.)

REFERENCES

- [1] Sawchenko, P. E. and Swanson, L. W. (1983). The organization and biochemical specificity of afferent projections to the paraventricular and supraoptic nuclei. In Cross, B. A. and Leng, G.: The neurohypophysis: structure, function and control. p19-27, Elsevier Amsterdam, New York.
- [2] Morris, J. F.: Organization of neural inputs to the supraoptic and paraventricular nuclei: Anatomical aspects. *ibid*, p3-8.
- [3] Sofroniew, M. V.: Morphology of vasopressin and oxytocin neurons and their central and vascular projection. *ibid*, p101-114.
- [4] Swanson, L. W., Sawchenko, P. E., Rivier L., Vale W. W. (1983). Organization of ovine corticotropin-releasing factor immunoreactive cells and fibers in the rat brain: An immunohistochemical study. *Neuroendocrinology*, **36**, 3 p165-186.
- [5] Pittman Q. J., Blume H. W. and Renaud, L. P. (1981). Connections of the hypothalamic paraventricular nucleus with the neurohypophysis, median eminence, amygdala, lateral septum and midbrain periaqueductal gray: An electrophysiological study in the rat. *Brain Res.*, **215**, 15-28.
- [6] Tribollet E. A and Dreifuss, J. J. (1981). Localization of neurons projecting to the hypothalamic paraventricular nucleus area of the rat: a horseradish peroxidase study. *Neuroscience*, **6**, 1315-1328.
- [7] Aulsebrook L. H. and Rolland, R. C. (1969). Central inhibition of oxytocin release. *Am. J. Physiol.*, **216**, 4830-4842.
- [8] Vincent J. D., Pominic Poulain, D. A. and Arnauld E. (1980). Electrophysiology of magnocellular neuroendocrine cells. In Barder J. L. and Smitu T. G. Jr: The role of peptides in neuronal function. pp230-272. Marcel Dekker Inc., New York and Basel.
- [9] Pellegrino, L. T., Pellegrino, A. S. and Cushman, A. J. (1979). A stereotaxic atlas of the brain, Plenum Press.
- [10] 邢宜仁、夏金辉、陈宜张 (1984). 下丘脑室旁核-下丘脑的区神经元对电刺激丘脑束旁核的逆行反应和顺行反应. *生理学报*, **36**(6), 595-600.
- [11] 宋朝治等 (1981). 侧脑室注射肾上腺素、缩宫素及加压素对叫反应的影响. *生理学报*, **33**(3), 283-292.
- [12] 宋朝治等 (1984). 侧脑室注射缩宫素、加压素及肾上腺素对清醒大鼠叫反应的影响. *生理学报*, **35**(4), 336-341.
- [13] 王璞石等 (1982). 下丘脑室旁核传入神经的起源. *解剖学通报*, **9**.

FILAMENTATION INSTABILITY OF WHISTLER WAVE IN THE MAGNETOSPHERE

Beijing KONGJIAN KEXUE XUEBAO [CHINESE JOURNAL OF SPACE SCIENCE] in Chinese  
Vol 6, No 1, Jan 86 pp 23-31

[English abstract of article by Wang Yuandian [3769 0337 3013] of Institute  
of Space Physics, Academia Sinica]

[Text] The filamentation instability of whistler waves in the magnetosphere is analyzed in this paper, and the growth rate is calculated. For propagation path  $L \approx 4$  and electric field of the wave 1 mV/m, the maximum growth rate is about 0.13/1000 km, the corresponding perpendicular wave length is about 400 km (near the equator region). It is also pointed out that the filamentation instability discussed here may offer a nonlinear mechanism for the multipath propagation of whistlers.

# NUMERICAL EXAMINATION OF AKASOFU'S ENERGY COUPLING FUNCTION

Beijing KONGJIAN KEXUE XUEBAO [CHINESE JOURNAL OF SPACE SCIENCE] in Chinese  
Vol 6, No 1, Jan 86 pp 32-41

[English abstract of article by Xu Wenyao [1776 2429 5069] and Shi Enqi [1597 1869 1142] of Institute of Geophysics, Academia Sinica]

[Text] Based on the general formula of the energy transfer rate from the solar wind into the magnetosphere, the coupling mechanism of MHD flow is examined by using solar wind data for a period of 34 days. It is shown that MHD flow mechanism is valid when  $B_z < 0$  (or IMF is southward). In this case the energy transfer rate can be expressed by  $P = C B_T^{2/3} V^{5/3} n^{1/3} \sin^4(\theta/2)$ . This is different from Akasofu's coupling function, but in good agreement with Murayama & Hakamada, Svalgaard, Murayama, and Holzer & Slavin. The factors influencing the calculations of coupling function are also discussed.

SELF-EXCITATION EFFECT OF SCATTERING OF ELECTROMAGNETIC RADIATION IN A STRONG MAGNETIC FIELD

Beijing KONGJIAN KEXUE XUEBAO [CHINESE JOURNAL OF SPACE SCIENCE] in Chinese  
Vol 6, No 1, Jan 86 pp 42-50

[English abstract of article by Liu Xuwei [0491 4371 0251] of Purple Mountain Observatory, Academia Sinica]

[Text] In light of the solution of electron motion equation in a magnetic field, the electron scattering in response to the incident electromagnetic wave of frequency  $\omega_i$  includes the part whose frequency is the same as the cyclotron one besides that of frequency  $\omega_i$ . This effect can be called the self-excitation and, except the highfrequency limit, has a considerable influence upon the cross section. In this paper, the modified cross sections of classical non-relativistic electron in the case of both a single electron and cold plasma are given. The spectrum distribution of electron scattering is discussed, and the Thomson absorption coefficients of magnetized thermal equilibrium plasma are obtained for some typical cases. It is also pointed out that the result here can be applied for many astrophysical aspects such as the spectrum formation of X-ray pulsars.

DYNAMICAL THEORY OF MULTI-FUNCTION DRY-TUNED ACCELEROMETER/GYRO

Beijing KONGJIAN KEXUE XUEBAO [CHINESE JOURNAL OF SPACE SCIENCE] in Chinese  
Vol 6, No 1, Jan 86 pp 75-80

[English abstract of article by Wang Huinan [3769 1920 0589] of Nanjing Aeronautical Institute]

[Text] In contrast to symmetric rotor of Dry-tuned GYRO (DTG), the rotor of Dry-tuned accelerometer/GYRO (DTAG) has different transverse moments of inertia and a proper rotor pendulosity. DTG can be improved to DATG. This instrument provides measurements of angular rate about two axes and linear accelerations along two axes. The study of DTAG is a significant effect on the development of Inertia Navigation System.

This paper presents the dynamical equations of DTAG. Under the condition of multi-frequency vibration, the stationary solution is computed according to the analyses of the dynamics. The feasibility of dry-tuned sensor technology for mechanizing an inertia grade four-axes multi-function sensor is demonstrated.

This paper also presents the condition of eliminating error torques resulting from angular vibration inputs of double spin frequency of the driving shaft. This condition is obtained by way of simple construction of single gimbal GYRO.

/7358

CSO: 4009/87

END

**END OF**

**FICHE**

**DATE FILMED**

**OCTOBER 16, 1986**